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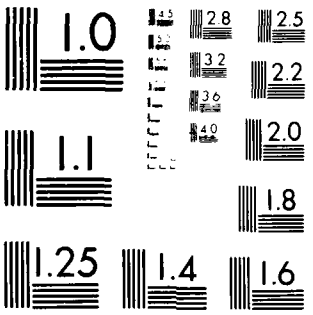

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OPERATIONAL SUSTAINMENT, LINES OF COMMUNICATION AND THE CONDUCT OF OPERATIONS

by

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This study examines the influence of operational sustainment, which includes lines of communication, on the conduct of major operations. After a definition of terms, two historical examples are analyzed, the impact of time and space on the conduct of operations - which includes sustainment - is examined, changes since the historical examples are placed in historical perspective, and conclusions and implications drawn.

The two historical examples used are MacArthur's return to the Phillipines and Slim's return to Burma. In both cases, operations were conducted at the terminus of extended strategic and operational lines of communication. In addition, those lines were restricted by the nature of the geography over which their operations unfolded. In MacArthur's case, the Pacific Ocean became his highway, while in Slim's case, he was forced to reduce sustainment to the minimum due to his operating over very tenuous and restricted LOCs.

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Time and space are the common bonds between operations throughout history and, despite changing technology, will continue to be the factors which commanders must operate within. The capability to improve performance and to compress the time/space continuum assists in the conduct of operations.

The conclusions reached are as follows: Logistics is operations; that although technology has improved our ability to compress the time/space continuum, the areas we will most likely fight in are unimproved theaters where technology's impact will be lessened; That the two historical examples used are very applicable today in preparing for operations in Southwest Asia and Latin America; and, That our current force structure and capabilities are not fully adequate should we be called upon to conduct major operations in an undeveloped theater.

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ABSTRACT

OPERATIONAL SUSTAINMENT, LINES OF COMMUNICATION AND THE CONDUCT OF OPERATIONS by Major Christopher A. Rockwell, USA, 51 pages.

This study examines the influence of operational sustainment, which includes lines of communication, on the conduct of major operations. After a definition of terms, two historical examples are analyzed, the impact of time and space on the conduct of operations - which includes sustainment - is examined, changes since the historical examples are placed in historical perspective, and conclusions and implications drawn.

The two historical examples used are MacArthur's return to the Philippines and Slim's return to Burma. In both cases, operations were conducted at the terminus of extended strategic and operational lines of communication. In addition, those lines were restricted by the nature of the geography over which their operations unfolded. In MacArthur's case, the Pacific Ocean became his highway, while in Slim's case, he was forced to reduce sustainment to the minimum due to his operating over very tenuous and restricted LOCs. Time and space are the common bonds between operations throughout history and, despite changing technology, will continue to be the factors which commanders must operate within. The capability to improve performance and to compress the time/space continuum assists in the conduct of operations.

The conclusions reached are as follows: Logistics is operations; That although technology has improved our ability to compress the time/space continuum, the areas we will most likely fight in are unimproved theaters where technology's impact will be lessened; That the two historical examples used are very applicable today in preparing for operations in Southwest Asia and Latin America; and, That our current force structure and capabilites are not fully adequate should we be called upon to conduct major operations in an undeveloped theater.

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" The whole secret of the art of war lies
in making oneself master of the communications. "

Napoleon

The evolution of military operations encompasses an almost steady growth in the distances over which those operations have been conducted. Ever since the first 'tactician' discovered he could strike his enemy by a means other than his fist, the range over which engagements have taken place has increased. This was a by-product of the evolution of weapons. As time passed, weapons and transportation means improved and the area over which engagements took place expanded. Increasing firepower and mobility, combined with the relatively unchanging nature of man, has resulted in a greater sized stage on which the drama of conflict takes place. From the first swat with a stick outside a neighbor's cave to a world at war, the scope of operations has increased dramatically.

Today we are entering a new era of technological advance as we pursue the Strategic Defense Initiative (SDI), and in the future we will move into space. Since the dawn of time, one aspect of operations has remained the same: Each participant has a base or bases from which he sustains his operations over lines of communication. This fact leads directly to the nature of this paper. The research question to be answered is: How does operational sustainment over lines of communication affect operations?

The answer to this question will be developed in five segments. The introduction is devoted to a discussion of the theorectical concepts involved in operational sustainment. Section II analyzes two historical

examples of operational sustainment over extended and restricted lines of communication. The third section consists of an analysis of the impact of the time/space continuum on sustainment and the conduct of operations. Section IV will address today's operational sustainment requirements, to include what has changed since the historical examples, and Section V will include the answer to the research question and address several implications for the Army today.

Operational sustainment, as I define it, is the provision of resources to the major formations in a theater of operations. It is not a new concept. Carl Von Clausewitz stated: " When an army begins an operation,... it necessarily remains dependent on its sources of supply and replenishment, and must maintain contact with them. They constitute the basis for its existence and survival." (1) These resources are normally provided from a base of operations. Jomini's concept of operational sustainment is essentially the same, with reinforcements and resources on which the army depends being provided from bases. (2) The definition found in FM 100-5 is "... those logistical and support activities required to sustain campaigns and major operations within a theater of operations. Operational sustainment extends from the theater sustaining base or bases which link strategic to theater support functions, to the forward combat service support (CSS) units and facilities organic to major tactical formations." (3) The six sustainment functions include manning, arming, fueling, fixing, transporting and protecting. (4) Strategic sustainment consists of provision of resources to the theater, while tactical sustainment is generally limited to receipt and distribution of resources to and among tactical units.

Bases of operation are areas of support/facilities from which support is provided. Clausewitz considers this to be basically the army's rear area or

home territory from which the resources are marshalled and sent forward. He conceives of the base and and the army in the field to be a single entity. (5) Jomini concurs in this basic definition. (6) Field Manual 100-5 considers a sustainment base to be an important if not critical complex or facility, at and from which sustainment resources are gathered and distributed. (7)

Lines of support (LOS)/lines of communication (LOC) is the next concept to be examined. Baron de Jomini states that " lines of communication designate the practicable routes between the different portions of the army occupying different positions throughout the zone of operations." (8) The zone of operations being a portion of the theater of operations which may be traversed by an army in the attainment of its object. Clausewitz is a bit more detailed on this subject, defining LOS/LOC as " roads that lead from an army's position back to the main source of food and replacements. They link the army to its base and must be considered its arteries. " (9) In addition to food and replacements, the other resources required to sustain the army move forward over the LOCs. Although other roads may link the base to its army, only those on which support and sustainment facilities are established are considered LOCs. He also considers these LOCs to have a second function which is to serve as lines of retreat.

Clausewitz believes that the value of the LOCs depends on seven factors: length; number; orientation; their state; the difficulties of the terrain;the condition and the temper of the local inhabitants; and the amount of cover given by fortresses or natural barriers. (10) One can visualize how these factors have influenced such historic LOCs as those of Napoleon's campaigns into Spain and Russia, the Santa Fe Trail, the Coast

Road in North Africa, the sea routes from the U.S. to Europe through the North Atlantic and the Ho Chi Minh Trail.

FM 100-5 describes LOCs/LOSs as the link between theater base or bases to the forward tactical formations, be they by air (ALOC), sea (SLOC) and/or land. (11)

The concept of interior versus exterior LOCs is also important in the discussion of operational sustainment. Jomini differentiates between interior and exterior lines by the ability to concentrate forces and maneuver. The commander able to do so more quickly than his opponent to oppose him a greater force is operating on interior lines. Operating on exterior lines, such as on the flanks of an enemy or against several enemy formations has the opposite result. (12) He also believes that logistic facilities should be echeloned in depth on different converging LOCs. (13)

FM 100-5 defines interior LOCs as interior to projected lines of action, behind and centered on the supported force. Interior lines offer the advantages of sustaining from central points, maximizing the capability of the support system with minimum cost in resources, and allow for the rapid shifting of resources. Disadvantages include the vulnerability of centralized facilities and divergence of LOCs as offensive operations unfold. (14) Exterior LOCs originate from multiple theater bases. Advantages include the convergence toward the objective as offensive operations unfold, and reduced risk of interdiction. Disadvantages include the requirement for significant sustainment resources to operate the forward flow of logistics, and an inherent dispersal of sustainment assets. (15) "Ideally, LOCs will be located so that shifts in operational direction can be accommodated without major adjustment of the sustaining effort." (16) FM

100-5 also envisions a mid to high intensity conflict as being characterized in part by operational sustainment over extended LOS.

The importance of LOCs is best expressed by B.H. Liddell Hart who states: "To cut an army's lines of communication is to paralyse its physical organization. To close its line of retreat is to paralyse its moral organization. And to destroy its lines of intercommunication - by which orders and reports pass - is to paralyse its sensory organization, the essential connection between brain and body." (18) Lines of communication are part and parcel of military operations at all levels and are as much a part of the unity of the military structure as tactical formations.

There are two theoretical concepts that also must be addressed in order to facilitate analysis of operational sustainment - culminating point and center of gravity.

Clausewitz defines several variants of the concept of the culminating point - defensive and offensive culminating points and the culminating point of victory. Examining these various aspects, one can derive a definition for a 'culminating point' as the point to which superiority can be carried, beyond which efforts are counterproductive. (19) FM 100-5 includes similar definitions for the offensive culminating point (20) and defensive culminating point. (21) The ability to sustain bears directly upon the approach toward, attainment or surpassing of the culminating point.

The 'center of gravity' is a Clausewitzian term which describes a characteristic of a state or military force. The center of gravity is the "hub of all power and movement, on which everything depends." (22) The center of gravity varies with the scenario. At the strategic level it may be the

capital, the alliance or personalities. At the operational level, it may be the army - some individuals believe this to be the only case. (23) Regardless, the center of gravity is the focal point for military operations - ours to be protected, theirs to be attacked. The center of gravity is the key to a cohesive effort. If it is overthrown the cohesion disappears, and that loss may spell defeat.

FM 100-5 includes an interpretation of the center of gravity concept. It states that centers can be found at all levels - tactical, operational and strategic - and differ depending on the setting. At the operational level, the center of gravity may be, among others, the logistical base, the lines of communication, or the force. This interpretation coincides with that of Clausewitz in the latter books (Four and Six) of On War. The manual also indicates that the center of gravity can change. (24)

While it is beyond the scope of this paper to delve into the concepts of culminating points and centers of gravity, those concepts are important in understanding the importance of operational sustainment and lines of communication.

SECTION II. HISTORICAL EXAMPLES

An examination of recent historical cases of operational sustainment and lines of communication on a major scale leads directly back to World War II. The most recent conflicts have been localized, such as Korea, Vietnam and the Arab-Israeli conflicts, or have been small in scope, such as the Falklands and Grenada. This is not to say, however, that lessons cannot be drawn from these conflicts. The war in Europe seems to be the favorite theater of war examined by historians, and that is why I have chosen my

examples from the Pacific - MacArthur's return to the Philippines and Slim's return to Burma. In both of these cases operations were sustained over long external lines of communication, and interior lines greatly restricted by terrain. MacArthur's campaign will be examined first.

Shortly after his arrival in Melbourne in March 1942, MacArthur was appointed Commander in Chief Southwest Pacific Area (CinC SWPA) (1) - a zone of war in the Pacific Area theater of war. (2) (See Map 1 and Chart 1 . He determined that the strategy for the defense of Australia must include striking enemy held islands and naval forces as they approached the continent. As the most lucrative targets in Australia were in the Northeast, to him it was apparent that it was from that direction that the enemy must move. Port Moresby on the southern coast of New Guinea occupied a key position as it controlled the air and sea LOCs southward along the Australian coast. To MacArthur, the prerequisites for victory were the seizure/development of airfields, ports and log stics bases. Moresby was the key to the defense of Australia and the springboard for a future offensive against Japan. Its seizure and development into a major air, naval and supply base would be MacArthur's first step in his return to the Phillipines. Australia became the COMMZ for the SWPA, the start point in the Jominian line of operations.

Australia had been chosen as a base to support the Phillipines in December 1941. (4) This decision resulted in the requirement to secure a long island LOC from the U.S. to Australia through the South Pacific. (See Map 2) This would become a strategic LOC which included Bora Bora, Samoa, Fiji and New Caledonia. (5) In June the Battle of Midway became a turning point in the war against Japan, and in July the JCS directed Nimitz and MacArthur to mount a joint offensive through the Solomons and New Guinea

with the ultimate objective of capturing Rabaul. MG George Brett, MacArthur's Fifth Air Force commander, determined he needed twelve additional airdromes for the campaign to include four at each of three places - Port Moresby, Milne Bay and Buna. (6)

As General MacArthur acknowledged at the outset of the campaign to retake Buna: "..the successful employment of any considerable number of troops on the north shore...was entirely dependent upon lines of communication." (7) Interior lines were extremely limited due to the impassibility of the Owen Stanley Range. Supply by air was not feasible until airfields were captured on New Guinea. The answer was the use of small, shallow-draft fishing vessels to transport supplies from Port Moresby to the east coast - see Map 3 (8) - which could navigate the dangerous reefs and approach close enough to the shore to be lightered through the breakers. (9) This scenario would be repeated throughout the return to the Phillipines.

Four major commands of the SWPA performed supply operations: General Headquarters (GHQ); the United States Army Service of Supply (USASOS); the Sixth Army; and the Fifth Air Force. The first two were the planners, the latter two the implementors. Logistics bases were classified as rear, intermediate and advance. Generally, rear bases were located in the Communications Zone (COMMZ), and obtained their supplies directly from local industry or agriculture, or from the United States. They supplied intermediate and sometimes advance bases. Intermediate bases, located closer to the combat zone, served as main suppliers of the advance bases which serviced the combat units. " The mission of the bases varied in detail with shifting strategic requirements, availability of shipping and changing locations of troop concentrations and combat zones. As the fighting spread northwest along the New Guinea coast, rear bases in Australia were either abandoned or

operated on a smaller scale, and advance bases became intermediate or even rear bases." (10) During operations in New Guinea, Australian bases functioned as semi-permanent rear installations and served as the COMMZ of the SWPA, organized into seven major bases. (11)

The LOCs into the theater - the strategic LOCs - were extended. (See Map 2) (12) From San Fransisco it was 6,193 miles to Brisbane, 5,800 miles to Milne Bay and 6,299 miles to Manila. Ships required more time to sail from the U.S. to the SWPA and back than to any other areas except China-Burma-India (CBI) and the Persian Gulf. (13) From Brisbane to Port Moresby was 1,500 miles. After the victories at Buna and Guadalcanal, Australia, New Zealand and New Caledonia were secure bases to support future offensives. " Stretching from Port Moresby to Fiji was a chain of advance bases that guarded vital areas to the south and rendered more vulnerable the enemy's forward positions. Communications with the U.S. were surer than before." (14) The securing of our LOCs thus had the operational effect of making the enemy's operational defenses less secure, the Japanese theater of operations beginning at Rabaul and extending back towards Japan.

MacArthur's next mission was the reduction of Rabaul. By amphibious landings he would seize air and naval bases in the Bismarck Archipelago - eastern New Guinea - Solomons area, bases that would render Rabaul powerless. Offensive operations proceeded along the New Guinea coast to include the seizure of Salamaua, Lae, Finschhafen, Saidor (Jan'44), then on to the Admiralties in March. The attack to seize Hollandia in Netherlands New Guinea had as its object the development of a supply point and air base. In July, 1944 the last operation in New Guinea took place - operation 'Globetrotter'. In the thirteen months of the campaign, MacArthur had advanced 1,500 miles by conducting amphibious landings which bypassed and cut off

Japanese centers of resistance. In September the final landings between New Guinea and the Phillipines were made on Morotai - a mountainous island covered with rain forest, as were most of the islands in the SWPA. (15)

A Small Ships Section had been established in the USASOS, and it included 19 trawlers, 4 harbor boats, 4 steamers, 2 speed boats, 2 ketches, 2 motor ships, 1 cabin cruiser, 1 schooner and 1 powered lighter. Within SWPA the bulk of the wartime traffic was by sea, from island to island and along the coastal fringes of the larger land masses. The shipping that supported the theater (operational sustainment over operational LOCs) also included ocean going vessels moving between the U.S. and rear, intermediate and occasionally advance bases. Thus, strategic sustainment was operating over both operational and tactical LOCs. All intertheater shipping was controlled by GHQ. By June 1945, the SWPA 'fleet' included 93 ocean going vessels, and by August it had received 531 barges, 203 freight supply vessels, 138 tugs and 106 marine tractors. as well as smaller numbers of floating cranes, small tankers and launches. (16)

" Nearly all military operations took place within coastal areas. There were few interior railways and fewer waterways. Army operations depended heavily upon ships and small craft to deliver men and materiel. New Guinea had no railways, few roads and only the most primitive, undeveloped ports." (17) As a result, throughout the SWPA engineering activities consisted mainly of base and LOC development. Over 95% of the movements in the theater were made by water. (18) These operations were along lines of operations, which do not necessarily coincide with LOCs.

On 12 March 1944, the JCS had directed MacArthur to prepare plans for an attack on Mindinao. His June plan called for a small scale attack on that island in October and a major amphibious landing at Leyte on 15 November. On

Leyte, an extensive base would be built to support an attack on Luzon. (19) The Leyte operation was subsequently moved up to 20 October. (See Map 4)(20)

In July 1944 the Army Service Command (ASCOM) was established under the Commander, Sixth Army, to plan the logistical support of tactical forces and to provide for the prompt construction of bases. These bases were to be started immediately after the landings and used initially as supply installations for troops fighting in their vicinity. (21) By this time, direct shipping from San Fransisco to advance bases was occurring more and more frequently. The establishment of ASCOM and direct shipping to advance bases was a belated recognition that tactical and operational level activities were being retarded due to the mistaken practice of disregarding base development in favor of rapid advances by combat forces. (22)

The road and bridge situation on Leyte was similar to that of New Guinea. Roads disintegrated rapidly under military traffic. Compounding the problem was the fact that the monsoon season started five days after the landings. Long stretches of road became morasses. " During the first three weeks, only three battalions in 10th Corps maintained roads in Leyte Valley: they could not cope with the rapid disintegration of the supply routes. The amphibious engineers saved the situation by moving supplies along the northern coast. Most roads were extremely difficult to repair once they broke down as they were built above the surrounding rice paddies. In the mountains, roads were almost impossible to construct. Combat battalions had to maintain 30-40 miles of their supply routes. Additionally, about 300 bridges had to be maintained on the island." (23) Interior lines were almost non-existent.

MacArthur had returned after two and a half years. His return had covered, by the time he reached Manilla, nearly 4,000 miles since he left Melbourne. It was a campaign of bases and operational sustainment over

exterior and interior lines, obviously extended as well as restricted. Logistics bases were established as nodes on the lines of communications, in keeping with Clausewitz's definition, and reserve stocks were built toward the rear, flowing forward as required, though slowly. Bases were the key to power projection. Air and naval power provided the means to project and protect the ground forces, and all three elements were tied to their sustaining bases. Operational sustainment was equal in importance to combat operations to the success of this campaign. The LOCs were, at the same time, the major constraint to operational advancement due to their nature, length and type. Although the combination of air and sea power was the center of gravity, operational sustainment, which included base and LOC development, was nearly also. Operational sustainment advanced the culminating point of victory in this campaign.

Nearly 6,000 miles northwest of Melbourne was the Imphal - Kohima area where another great soldier, Field Marshall the Viscount Slim had begun his 'return' in December 1944 with a tremendous victory over the Japanese.

The Axis situation was growing steadily weaker by this time. In Europe the Allies were north of Florence on the Gothic Line, and had pushed across France to the western border of Germany. The Russians were entering Germany from the east. In the Pacific, U.S. forces were approaching Japan, and the Japanese fleet had been defeated at Leyte Gulf. In CBI, the Japanese posture was an operational defense, ".. with Thailand and the Maylayan Peninsula as the outer periphery of a self-sufficient military zone which would block the progress of Allied forces toward Singapore and the South China Sea, even though it was cut off from the Japanese islands by relentless U.S. submarine warfare against its shipping lanes. The role of the Japanese forces in Burma was to attempt to block the reinforcement of China over land." (24)

Scutheast Asia was an Allied theater of war with Vice Admiral Lord Louis Mountbatten as Supreme Commander. Allied forces in Burma, a theater of operations, were under the command of General Slim, the 14th Army commander. (See Map 5) The British Chiefs of Staff had as the object for operations in Burma: " To develop and protect the air link to China in order to provide maximum and timely flow of POL and stores in support of Pacific operations ... exerting maximum ground and air effort... exploit the development of overland communications to China. " (25) A lack of landing craft made land operations into Burma the only means possible.

" Slim was faced with the prospect of using a numerically inferior force, operating at the end of precarious lines of communication; while the enemy operated on interior lines of communication, with good roads and rivers, and a railway system which, in spite of our bombing, was still managing to keep sufficiently open for essential moves." (26)

Slim's original plan was to defeat the Japanese Burma Area Army with his 4th and 33d Corps in a decisive battle on the Schwebo Plain west of the Irrawaddy. He was limited in the size of the main force he could employ by the extended lines of communication over which he had to operate. (See Maps 6 and 7) His plan also called for support from two other forces. The 15th Corps was to seize three islands off the Arakan coast and to establish air supply bases on them which would support a subsequent drive southward to seize Rangoon. (See Map 3) The Northern Combat Area Command (NCAC) would conduct limited offensive operations in the northwestern part of the country to tie down as many forces as possible.

The offensive began on December 3, 1944 with only one division of the 4th Corps committed as a decoy to the north of 33d Corps. After a week of rapid

progress Slim realized that the Japanese intent was to fight along the banks of the Irrawaddy and he was forced to alter his plan.

Slim's new plan was to cross the Irrawaddy with one corps - the 33d - to seize Mandalay. His 4th Corps would conduct a deception operation to convince the enemy that it was moving with 33d Corps as part of the main effort against Mandalay. In fact, the 4th Corps would be the main effort and would slip southward behind the Pondaung Range, cross the Irrawaddy near Nyaungu and seize Meiktila, a critical logistics base where air, road and rail nets intersected. (See Map 9) Meiktila's capture would cut off Mandalay and force the Japanese to withdraw from Mandalay to secure their LOCs. Once these two objectives had been seized, 14th Army would drive rapidly southward to seize Rangoon. Slim knew that he had to have the use of a port in south Burma by May or else the monsoons would interrupt his sustainment over vulnerable LOCs.

The change in plans required the move of 4th Corps from the Army left to right flanks, thus crossing the corps' LOCs. This required a movement over a rough, hilly track 320 miles long, to be followed by a buildup of supplies for a major river crossing, to be followed by offensive operations. The route had to be improved and required a major engineering effort. Over this one road all men and materiel for the main effort must pass. To ease the burden on that single route, a 'fleet' of boats, barges and rafts were constructed from locally available materials which would eventually transport hundreds of tons of supplies daily. (27) This situation exemplifies how a theater of operations can be defined by the COMMZ as a base of operations, and the remainder of the theater defined by the extension forward of lines of operations.

Air supply was also crucial and the C47 cargo plane was available to Slim in limited numbers. This aircraft, the largest cargo plane then available, carried the same payload as a two and a half ton truck, and its range was only 250 miles, thus the importance of 15th Corps' mission. (28)

The 14th Army's LOCs would in May, after the monsoon season began, consist of: an all-weather road from the railhead at Dimapur to Tamu (206 miles); fair-weather road from these to Kalewa (112 miles); over Bailey Bridge, fair and all-weather road to 33d Corps at Mandalay (190 miles); down the Chindwin River by boat to 4th Corps at Myingyan (200 miles); and finally over 4th Corps' all-weather road from there to Meiktila (59 miles) (See Map 7) (29). From Dimapur to Mandalay it was 508 miles, and to Meiktila it was 573 miles. Dimapur was the terminus of strategic LOCs eminating from Calcutta and Chittagong. From Calcutta, to get supplies by rail to Dimapur, they travelled 464 miles, were transferred to a ferry across the Brahmaputra River at Gauhti, then back on rail an additional 145 miles. By river, they travelled 828 miles to Gauhti, then onto rail. There was no overland route. From Chittagong there was only a rail route to Dimapur, and that was approximately 420 miles long. However, Chittagong was incapable of supporting a major offensive. (30) (See Map 6)

" The problem presented by the inadequacy of existing communications in northern Burma was aggravated by the fact that, although our operations were essentially part of one strategic pattern, they were geographically remote from each other, separated by vast obstacles." (31) Additionally, as the advance progressed, the Allies' LOCs were extending, while the Japanese were falling back on theirs.

As the operation unfolded, 33d Corps gained ground rapidly against a two-

division Japanese covering force, and by the second week of January was near the Irrawaddy. Crossing that river was a major operation itself due to the width - in places up to 2,000 meters. It was to be conducted with minimal crossing equipment against an enemy determined to defeat it as it attempted to cross. Its success was due, for the most part, to the Japanese failure to respond quickly and decisively. Allied air superiority was also a key factor in its success, through the provision of air cover and preventing Japanese observation of movements. Fourth Corps' movement southward went undetected.

Operating over extended and constricted lines made life interesting for Slim, who states that every day there was one type of logistical crisis or another. "Time and again, and just in time, the bare essentials for our operations reached those who so critically needed them. Very rarely had any formation more than its basic needs." (33)

On February 21st 4th Corps crossed the Irrawaddy and a reinforced division began the drive on Meiktila. The city was captured on March 3d and shortly thereafter the Japanese launched a series of counterattacks. Savage fighting continued until the last week of March when 4th Corps ultimately prevailed.

On Slim's right flank, 15th Corps had seized the islands of Akyab, Chaduba and Ramree at the end of January, and at once began to build air-strips and marshall supplies to support his drive to Rangoon. On his left, the NCAC had secured the Ledo Road on 27 January but had ceased moving south on 16 March when the Chinese 1st Army halted 35 miles southwest of Lashio and 100 miles from Mandalay. This had permitted the Japanese to break contact and withdraw south to face 14th Army.

Simulthaneous with 4th Corps' Irrawaddy crossing, the 33d Corps began its crossing. On the 26th of February the breakout from its bridgehead began and

by March 8th elements of the corps were on the outskirts of Mandalay. (See Map 10) (34) As Slim had anticipated, the Japanese had withdrawn some forces from the city to assist in the battle at Meiktila, and on March 20th, the city fell. Now, " Both banks of the Irrawaddy from Mandalay to Chauk and the main road and railway to Rangoon were in our hands." (35) Next came the race to Rangoon, with the three participants being the remainder of the Burma Area Army, the 14th Army, and the monsoon season.

Slim's main anxiety was his ability to sustain operations. His motor transport was weak from tremendous usage, the LOCs were extended and the approaching monsoon season did not allow for an operational pause. He had to rely on stripping units returning to India of vehicles, and increasingly on aerial, water and limited railway supply. From Meiktila it was 320 miles along the railway to Rangoon, and from Chauk it was 370 miles. (See Map 8) He figured he had 40 days after mopping up operations in the vicinity of Mandalay and Meiktila. Slim chose two lines of advance - 4th Corps moving along the railroad and 33d down the Irrawaddy Valley. The advance began on March 30th.

As Slim advanced southward, his LOCs were further extended. " The troops of 4th Corps were on reduced rations, having given up food for petrol and ammunition. " (36) Speed was of the essence, yet the drive had to be sustained. In 4th Corps a system of leapfrogging divisions was developed. The leading division, with armored and and motorized units, would bound ahead to seize an airstrip or a site for one. Airfield engineers were then flown in to prepare it for the arrival of an air transported brigade. That brigade held the airstrip, cleared the area, reinforced the attack or opened/kept open the main road for the following division, which passed through to seize the next airstrip, and prepare for the cycle to repeat

itself. To save ground transport capability, airstrips were located preferably no more than 50 miles apart. The rate of advance of the corps was directly related to the speed that airstrips could be brought into operation. At times airfield engineers were in the leading elements of the division. (37)

On May 1st, the monsoon season hit - two weeks early. That day an airborne landing was made outside Rangoon and on May 2d an amphibious landing was made by the British 26th Division - landing craft having been unexpectedly made available by that date. These landings were to support 14th Army's advance from the north. It was soon discovered that the Japanese had left the city and by May third Rangoon was in Allied hands. The remaining Japanese forces in Burma were defeated by Slim's successor as he was then appointed Allied Land Forces Commander. While he was on leave in England in June, the dropping of the atomic bombs occurred which led to the formal Japanese surrender on September 12, 1945. The Japanese forces in Southeast Asia surrendered in Singapore.

Slim comments that the nature of the terrain and the LOCs forced his units to do without, and that they discovered that they could advance more rapidly with fewer vehicles and exist on little more than one fourth of the tonnage which was projected that they would require for sustainment. Training, morale and improvisation overcame many of the logistical constraints. Slim compares his efforts with those of MacArthur and believes that they fought with the most advanced modern techniques. His forces fought " .. on a front of 700 miles, in four groups, separated by great distances, with no lateral communications between them and beyond tactical support of one another, " (38) thus operating successfully over exterior lines. He states that: " We were the first to maintain large formations in action b-

air supply and to move standard formations long distances about the fighting front by air" [39], and he considered the ALOC key to future operations.

The Burma campaign offers us an example of what can be accomplished when operational sustainment is conducted over extended, exterior and restricted LOCs. It was a brilliantly executed campaign, conducted on the fringe of the attainable, which is why the enemy was caught off guard time after time. LOC and base development planning was a part of the campaign planning process and determined the pace of advance. Although I believe that Allied air power was the operational center of gravity, once again the ability to provide sustainment over tenuous LOCs comes close, and was considered crucial by Slim himself. In this example, sustainment delayed the culminating point of victory. Improvisation was key to Slim's success, with engineers and transporters doing the seemingly impossible with locally available resources. Most importantly, Slim believed in and utilized his logisticians in every facet of his operations.

Both MacArthur and Slim understood that they had to match ends with means. Their campaigns were strikingly similar. Each relied on extended lines of communication and the development of bases to support the next phase of their advance. Neither operated over interior lines, and neither had a standard road or rail net to support their operations. Both fought in secondary zones of war where their operational LOCs were constrained by time, distance, priority and the nature of the terrain. Both fought in undeveloped theaters of war. Both commanders understood that sustainment was, in fact, operations. With MacArthur, his center of gravity protected both his bases and his lines of communication, prevented enemy forces from massing and ensured air superiority. Slim's accomplished the same function, and served the dual function of not only protecting his vulnerable LOC, but

as a key ingredient in the sustainment process as well. Both commanders forged their own LOCs and developed their own sustainment processes. Additionally, both commanders struck at the enemy LOCs, successfully cutting their lines of operations from their bases of operations. Both examples provide excellent studies for operations in an undeveloped theater.

SECTION III. THE IMPACT OF TIME AND SPACE ON LINES OF COMMUNICATION AND OPERATIONS

The time and space continuum is a conceptual framework for evaluating events. Events such as the resupplying of repair parts or the conduct of a military operation take place in 'space', be it in a specfic location or across a defined geographic area - air, sea, land or any combination thereof. Operation Overlord involved land, sea and air operations, as did MacArthur's return to the Phillipines. Slim's return to Burma was essentially a land and air operation. Events also occur over time. Some events are of short duration, such as the German conquest of France in 1940, while others take longer, as with MacArthur's return. The time/space continuum is used to evaluate events using both criteria.

When one examines the concept of 'space' it becomes obvious that it is not simply a portrayal on a map. First there is the nature of the space. Land, for example, includes a variety of geographic considerations - ocean, desert, jungle, forest, wadis, developed and undeveloped areas, roads, man-made structures, etc. Weather has an effect on space. Precipitation may impede eyesight and slow the rate of travel, and it may lead to the creation of mud which also may slow travel. Daylight and dark has an effect on the use of space.

'Time' also is not a simple concept. The ability to determine how long an event or a series of events will take to unfold has been a challenge for every military leader and I imagine always will be. In addition to determining how long it will take one to accomplish certain tasks, a determination must also be made of the enemy's intentions and capabilities.

The concepts of time and space, therefore, are relative. The ability of the antagonists to master the time/space continuum is crucial in determining victory, as operations occur in this continuum.

B.H. Liddell Hart believes that: " Problems of normal warfare are conditioned by the factors of time, space and force." (1) He presents an interesting case in point with the German invasion of France at the beginning of World War II. Both the French and German high commands felt that a crossing of the Meuse River could not occur until the ninth day of the war. (2) When Guderian's corps began crossing on the third day, the French were unable to respond successfully despite occupying key terrain and prepared positions. Both sides had an appreciation for the terrain, and even at the highest staff level, had the same appreciation for time. One side, however, was able to exploit the situation as the tactical commander - Guderian - was able to accomplish the move to and across the river much more quickly than the other side, indeed his own superiors, thought possible. This example, and there are many others, to include Slim's race to Rangoon and the Egyptian crossing of the Suez, is an illustration of one aspect of the time/space continuum: given the same conditions, there may be more than one possible solution to accomplishing a move across time and space. As Sun Tzu says: " Appear at places to which he must hasten; move swiftly where he does not expect you." (3) Liddell Hart echoes this feeling with his belief that: " Time and surprise are the two most vital elements in war." (4)

Sun Tzu believes there are five elements in the art of war. " First, measure of space; second, estimation of quantities; third: calculations; fourth, comparisons; and fifth, chances of victory." (5) 'Calculations' include the degree of difficulty of the enemy's land and the directness and deviousness of its roads. " Knowing the distances, one can make use of an

indirect or direct plan. If he knows the difficulty of traversing the ground he can estimate the advantages of using infantry or cavalry. If he knows the ground is constricted and where open, he can calculate the size of the force appropriate. If he knows where he will give battle, he knows when to concentrate and when to divide his forces." (6) Sun Tzu was aware of the time/space continuum as well as the need to sustain the army over that continuum. " An army which lacks heavy equipment, fodder, food and stores will be lost." (7)

Liddell Hart shows his appreciation for the continuum in numerous places in his book Strategy, the best example being: " Movement lies in the physical sphere, and depends on a calculation of the conditions of the time, topography, and transport capacity. (By transport capacity is meant both the the means by which, and the measure in which, force can be moved and maintained.)" (8) This appreciation is of tremendous importance as one attempts to conduct operational sustainment over lines of communication.

In both of my historical examples, allied forces were operating at the end of tremendously long LOCs. It was 5,800 miles from San Fransisco to Milne Bay. A transport averaging 15 knots would take about 15 days steaming non-stop to make the trip. That is one aspect of the sustainment space and time continuum. In late January 1944, Milne Bay Harbor held as many as 140 ships,some of which had been there over a month waiting to be unloaded. Similar problems were experienced at Hollandia and Leyte. Cargo discharge generally was slowed due to lack of port facilities, a shortage of labor, a shortage of trucks, mud, rain, and enemy air raids. The lack of storage space ashore resulted in the tendency to use Liberty ships as floating warehouses, thus reducing the time that they could be transporting supplies across the Pacific. (9) At Tacloban, Leyte's port, within four days of the

arrival of the first Liberty ship, there were 56 air raids, to include Kamikaze attacks. Within three months, there were three typhoons, and thirty three inches of rain fell. Such 'events' as rain, unloading, storage of supplies, air raids and shortages of trucks take place in a very small 'space' - several square miles - yet even though this is only a minute fraction of the LOC, it takes 'time' to overcome. The order-ship time for engineer supplies during this campaign, for example, approached 300 days. (10) If those supplies had been crucial, either another means of sustainment would have had to have been found, or operations would have slowed even further.

MacArthur's campaign from Australia to Leyte had covered 4,000 miles in two and a half years, an average of 4.4 miles per day. Flying at 150 miles per hour, he could have covered the distance in 26.75 hours. Indeed, " tactical considerations - geometric factors in the disposition of forces and tactical arrangements - were reflected only faintly in 'operations', with its concern for great spans of time and space." (11)

Slim's return was more condensed in time and space. It is 450 miles by air from Imphal to Rangoon, but 720 miles by land LOCs. Slim did not have the luxury of sustainment assets arriving at advance bases during his campaign. Supplies came via one route, beginning at the terminus of strategic LOCs at Dimapur, 80 miles northwest of Imphal. From there a combination of rail, truck, water and air were the vehicles of operational sustainment. It took Slim 155 days to reach Rangoon, an average of 2.9 air miles or 4.6 land miles a day. He could have flown to his objective in 3 hours if travelling at 150 mph. The words of Jomini are applicable in this example. In marching, calculations of times and distances depend upon: " 1, the distances to be passed over; 2, the amount of material in each train; 3, the nature of the

country; 4, the obstacles placed in the way by the enemy; and 5, the fact whether or not it is important for the march to be concealed or open." (12)

Slim operated over exterior lines of communication until he had seized Meiktila and Mandalay, and then over interior lines. He relied essentially upon the one major LOC running from Dimapur forward. Aerial resupply was utilized to the maximum extent possible in an attempt to compress the time/space continuum, but the main source of supply was still Dimapur. The nature of the theater of operations - the space and the time to traverse that space - did not, however, permit the rapid shifting of support priorities from one corps to the other. Based on this fact, Slim task organized his force with the limited means of operational sustainment allocated between both. Thus, the continuum was utilized in the plan of operations. Slim's appreciation for the time/space continuum included not only the nature of the terrain, but his and his enemy's capabilities and the impact the approaching monsoon season would have on operational sustainment. Based on this analysis, he adjusted the task organization to light forces on one approach and mechanized and airborne on the other, thus matching ends and means.

MacArthur operated on exterior lines of communications. His support bases included not only those in the theater itself but those outside as well, such as San Fransisco. The system of advance, intermediate and rear bases was established as the campaign unfolded. As an appreciation of the time/space continuum's effects on operations grew, the strategic LOCs were run directly into the advance bases. The tremendous distances involved in this campaign, in conjunction with the nature of the theater, predetermined the utilization of exterior lines.

A normal disadvantage of exterior lines, the difficulty in shifting sustainment flow, was not so pronounced in this campaign as the LOCs were

over water, and ships were able to be redirected to wherever their cargo was required. There still were difficulties, however, such as the lack of port facilities and the inexactness of cargo manifesting. The inefficiency of the management of sealift operations was a factor in the sustainment portion of the time/space continuum.

Operational sustainment in the SWPA can be viewed in several segments. First is the shipment from the rear bases to advance or intermediate bases. This was essentially the time it took for the ship to sail to the base - a function of space. The second segment was the time it took to unload, sort and store the supplies at the base. This was a function of time. The final segment was the delivery of resources forward to the combat units. Due to the nature of the land over which operations were conducted, characterized by jungle, stream, and a lack of roads and rail, this was a function of both time and space. The forces in the SWPA advanced in conjunction with the development of operational sustainment capability.

Both MacArthur's and Slim's campaigns revolved around operational sustainment. Slim's timetable for the accomplishment of his mission was driven by the nature of his LOCs, the distance he had to travel, the date the monsoon season was expected to start, and the nature of his and his enemy's forces. MacArthur recognized his campaign as one of the development of bases to sustain his defeating and bypassing of enemy centers of resistance. The conclusions to be drawn are clear. Operational sustainment cannot be separated from the conduct of combat operations. In assessing an operational mission, one of the first requirements is to determine the distances to be covered and the nature of the terrain to be traversed. Recognizing that time and space is relative to the enemy, an appreciation of capabilities and likely courses of action/reaction must be gained. Each part of the analysis

must include the operational sustainment requirements. The result of the analysis will be a campaign plan that incorporates combat and sustainment plans which are complementary.

Clausewitz states: "... the forces available must be employed with such skill that even in the absence of absolute superiority, relative superiority is attained at the decisive point. To achieve this, the calculation of space and time appears the most essential factor." (13) The 'forces', I contend, include the provision of operational sustainment.

SECTION IV. CHANGES IN OPERATIONAL SUSTAINMENT

To say that things have changed since the end of World War II would be one of the greatest understatements of the day. Yet, 'la plus la change, la plus la meme chose'. The time/space continuum and all it implies will always be a requirement. What changes is how we contend with it.

Ships and planes are larger and faster. A C5B can carry nearly 50 times the tonnage of a C47 and fast sealift ships can carry a division from the east coast of the United States to Gibraltar in ninety-six and a half hours. Yet despite their modernity they still encounter the same types of weather, and they still have to unload somewhere. Bigger transports equates to a requirement for bigger terminals. The limited port facilities - port referring to both air and sea - in Southwest Asia, Latin America and many other areas, greatly impacts on the ability of the U.S. to introduce forces and their sustainment into a theater of operations in those areas. For example, in many countries, a C130 is the heaviest aircraft that can land on any but a few airfields. Although this primarily concerns strategic sustain-

ment, it has an operational impact, and may, in fact, be operational sustainment. Offloading is conducted in the theater of operations, where strategic and operational lines interface. This crucial node will be discussed later in greater detail. The capability to get sustainment into a theater is a major change.

Changes in speed and size are examples of the major change since my historical examples - technology. Today is different from WW II because technology has altered the way operations can unfold over the time/space continuum - it has compressed the continuum. War can come overnight, and we will not have the time to mobilize and 'get our act together' that we had in 1940-42, when it was 18 months before we launched a major offensive. (1) " Technology has increased the speed at which warfare can happen." (2) The Soviet Union can strike the continental United States with land or sea based missiles with only a few minutes warning.

One senior officer, USAF General James F. Mullins, feels that our high technology has resulted in a 'logistics dependency' which: " limits the operational capabilities of our forces and, in the process, threatens the ability of this nat on to defend its vital interests." (3) The dependency, he claims, is a vulnerability resulting from the development of sophisticated weapons systems which rely on specially trained maintenance personnel, utilizing expensive, sophisticated diagnostic and repair equipment and repair parts, and frequently requiring sophisticated repair facilities. Examples of high technology Army equipment would include fire control, optical, commun cations and intelligence systems utilized and maintained at the tactical and operational levels.

A second difference since the historical examples is the change in our merchant marine force, which enabled MacArthur to conduct his campaign. By

the end of World War II, the U.S. had an inventory of 5,300 merchant ships and today we have only 420 in service. (4) MacArthur's 'fleet' for the Leyte operation alone included 500 ships. (5)

This ties in with the third change, that of the nature of today's Army and the amount of sustainment required to support it. In Slim's campaign he sustained his divisions on 120 short tons of supplies a day, whereas in other theaters, divisions received 400. (6) Based on current U.S. planning factors, our units require much more. A J-Series MTOE armored division fighting in the Middle East might require over 5,400 short tons of supplies daily, and a J-Series MTOE mechanized division fighting in the Pacific area may require over 3,700 short tons daily. A light division fighting in an area similar to the Canal Zone, such as Southeast Asia, would require over 1,700 short tons each day. (7) (See Chart 2) Undoubtedly a lot of this tonnage could be dispensed with, such as Class VI (personal demand items) and most Class II (individual and administrative supplies), while some, such as Class IV (construction supplies) could be made up from locally available supplies. The fact is that between 85% and 90% of the tonnages are for Classes III (POL) and V (ammunition). We have more and heavier vehicles and more, heavy, ammunition consuming weapons systems. Providing sustainment at the operational level to corps made up of high consuming divisions will be a tremendous challenge.

The fact that our operational units are difficult to sustain is, of course, relative. The factors of where and under what conditions the sustainment is conducted is crucial to the ability to sustain.

" Low intensity conflict (LIC) will likely be the most pervasive threat to free world security for the remainder of this century", (8) a theory propounded by Professor Martin Van Creveld in his March 27th visit to the

School of Advanced Military Studies. Operations such as Urgent Fury in Grenada and the British action in the Falklands are LIC-type operations which, though small in scale, required a massive logistical effort. Many experts predict that U.S. participation in these types of operations rather than in a mid or high intensity conflict is the most likely in the immediate future. Although Grenada was close to the continental U.S., the Falklands were not close to England. For that reason it is worth examining briefly the operational sustainment implications of this recent operation.

In the case of the Falklands, strategic lines of communication were approximately 8,000 miles long. An advance base was set up on Ascension Island, but that was only half way to the objective. A Tug, Repair and Logistics Area (TRALA) was established at sea approximately 220 miles from the Falklands where support vessels conducted supply transfers and battle damage repair activities were conducted. This became a floating advance base and the beginning of the COMMZ, with Ascension becomming a rear base. The lack of port facilities and good beaches in the objective area resulted in extensive use of helicopters for logistics over the shore (LOTS) operations. (9) The harbors and beaches became the forward part of the COMMZ.

Another interesting aspect of this conflict was the British use of requisitioned shipping to support the operation. A total of 26 ships were requisitioned, referred to as 'ships taken up from trade' (STUFT), and all were quickly adapted for military use. All were modified to some extent, e.g. the fitting of helicopter platforms and installation of military communications systems. The Canberra, a cruise ship, was used as an assault ship in the landing at San Carlos, and a North Sea oilfield support ship was used to provide a maintenance and repair facility. (10)

The Falklands experience demonstrated that a fleet of 60 ships was required to: " regain and secure a fairly limited objective. It has been estimated that several hundred merchant ships might be needed in order to sustain U.S. troops in Southwest Asia. These ships do not now exist in our merchant marine. Nor do we have sufficient shipyard facilities to perform modifications on those ships on even as limited a scale as the British accomplished. " (11)

The Falklands is not unique as we look around the globe to where we might be committed. " In many remote areas of the world, particularly Southwest Asia, arriving forces must be moved great distances before they can be employed in battle. Road and rail nets in these areas are poor or non-existent. Intratheater airlift often provides the only means to move combat equipment and units into forward locations, " (12) and even in this area our forces are restricted by aircraft availability, suitable landing sites, aircraft capability to transport large quantities of heavy materiel, and the status of air superiority. Intratheater airlift of any magnitude depends on the C130, which eventually will be replaced by the C17.

Even then, one must be aware of the sustainment requirements, as mentioned above, and the capacity to move large tonnages by air. In the CBI Theater, the 'Hump' was flown from April 1942 after the Japanese had cut the Burma Road, and continued through July 1945. In three and a quarter years, only 650,000 tons were delivered. At that rate today only one light division could be supported for 380 days, or one armored division for 119 days. During the Hump operation, 800 aircraft (more than all C141s, C5s and C130s combined) and 1,000 airmen were lost. (13)

In order to prepare for future contingencies, DoD is taking action with the goal of ensuring that power projection - to include operational

sustainment - can be successfully conducted over extended and restricted LOCs. Joint efforts in LOTS operations are progressing, as evidenced by such major exercises as JLOTS II in 1984 and Bold Eagle '86. Self sustaining ships that can discharge directly onto lighterage and barge ships which launch barges to tow ashore are being acquired. Roll-on/roll-off ships are also being acquired which can discharge vehicles on lighters, and modular causeways are being developed. Included in the Army's LOTS program are two companies of LACV-30 air cushioned vehicles, other lighterage equipment, and modernization and upgrade of its watercraft fleet. (14)

To assist in operational sustainment, the Navy is instituting several programs that will operate in conjunction with LOTS. Their container off-loading and transfer system (COTS) and offshore bulk fuel system (OBFS) are part of their amphibious logistics system (ALS). Both of these programs are designed to operate where port facilities are limited or non-existent. (15)

As previously mentioned, the Air Force's development of the C17 will greatly assist operational sustainment. " The C17 can carry the largest combat vehicles the Army owns, directly into the combat area, and is MAC's answer to replace the C130 and the C141." (16)

Additionally, the Maritime Prepositioning Ships (MPS) and Near Term Prepositioning Force (NTPF) are examples of programs with tremendous operational sustainment implications, as they help compress the time/space continuum. They provide for the delivery of onboard unit equipment, ammunition and supplies of Marine Amphibious Brigades. Troops link up with this materiel in a non-hostile port and are then employed. (17) Army programs such as POMCUS in Europe and pre-positioned war reserve stocks (PPWRS) on the Arabian peninsula are other means of dealing with the continuum.

A restriction on preparing for contingencies is the fact that as the great majority of DoD containerized cargo is shipped using the services of commercial ocean carriers, duplicating private industry capability by purchasing government owned containerships and containers cannot be justified. (18) It thus appears that the Navy has gone about as far as it can go with strategic mobility via active ships, and thus will have to develop additional capability with some other means. Solutions will have to be joint, such as the Army's attempts to lighten units.

In summary, the changes since the historical examples are mainly technological, just as they have been in every era. Technology is employed to overcome obstacles inherent in the time/space continuum. Armies attempt to achieve greater effects through the use of technology as has always been the case. Today we have greater means than before with our sophisticated planes, ships, tanks and communications. The challenges to synchronize are commensurately greater as well, as are the needs of operational sustainment. The world is still the same size, and man's attempts to change the topography are, in retrospect, minimal. In many undeveloped areas, the attempts to modernize communications, such as improved transportation capabilities, have been non-existent. The ultimate challenge of current contingency planning, therefore, is to maximize the effects of our technology/capabilities and apply those effects in the physical sphere of the theaters of operation.

SECTION V. CONCLUSION AND IMPLICATIONS

Operational sustainment is the physical linkage between strategic and tactical sustainment, just as operations is the linkage between strategy and tactics. Its framework is the time/space continuum. Graphically, it may be represented by a series of lines with the points of intersection called nodes. Lines and nodes are strategic, operational, tactical or a combination of two or three, (See Chart 3) as throughput distribution of supplies may bypass intermediate nodes, and is used to compress the time/space continuum. Our first example of throughput was the shipping of supplies to advance bases (nodes) in the SWPA directly from San Francisco in WW II.

General James P. Mullins states: " We must acknowledge that our strategy and tactics will only work to the extent that our logistics will allow ... If our national security requires that we enter unforseen conflicts in the far reaches of the globe, and if these conflicts do, in fact, grow to very intense levels within hours, our present logistics might well prove inadequate, especially in terms of sustaining our force. " (1) He is speaking of a worst case scenario in which there is no opportunity to utilize the capability of reserve forces and to marshall required transport, upon which we have grown more and more dependent. The fact is that reserve units take time to activate, integrate and deploy, and this is something that dictates time must overcome. This 'time' must be provided by our intelligence community and the civilian leadership of our country, which must make mobilization decisions.

" Very sudden is the transition from peace to war, and one must consider that lines of communication are established which do not normally exist in peacetime, and that those detailed to maintain them are not likely to have experience in that area. " (2) " The administration of the communications

is a very difficult and complicated task, and can only be regulated by a suitable organization carefully prepared and thoughtfully planned during peace. " (3) These two statements are taken from the only book on lines of communication in wartime, and it was written in 1894. They hold true today. There cannot be operations if sustainment does not flow over LOCs. Logisticians must be able to grasp the operational requirements in order to structure and maintain the LOCs which link the sustaining base to the tactical organizations.

It is interesting to note the structure of combat versus logistical organizations. Combat units are located chiefly at the division level, with some elements at the corps and few at the army group levels. A schematic of combat unit distribution thus resembles a pyramid. Combat service support units, however, are structured in the opposite manner - an inverted pyramid with few, small units at the division level, with more at the corps and army group levels, and located further to the rear. (See Chart 4) This structure when stratified provides more logistical assets to higher level commanders than combat assets. Logistics responsibilities weigh heavily on the more senior commanders and become a primary means of influencing the conduct of operations. Logistics is operations.

Further reinforcing this point is the requirement for theater commanders to ensure that the nodes at which strategic, operational and tactical lines of communication interface are functional. We have seen their importance in the two historical examples, as well as in the Falklands campaign. MacArthur developed advance bases as the building blocks to his operational design. " The logistics continuum is a system of nodes, or links. Our ability to define and understand the interfaces between the nodes is essential to maximizing the overall capability and flexibility of the total logistics

system." (4) As with any system made up of subsystems, it is where they interface that they are most likely to fail. The Sergeant York system is a good example of this.

MacArthur's campaign in the SWPA is especially relevant today in light of potential areas of conflict. In Southwest Asia, sustainment bases can be looked upon as islands, with truck transport among them filling the same role as ships in the SWPA. Distances in the theater are long, with desert and mountains and lack of a developed communications system filling the same role as the ocean. There are few railroads in the theater, and our air assets are still incapable of sustaining heavy forces. Port facilities are as limited as they were in the SWPA. In Latin America we also have an analogous situation. Although distances in some areas are not large, the theater is undeveloped, with jungles, rugged terrain and an extremely limited road, rail and communications network. Airfields are mainly limited to light aircraft. These obstacles also are analogous to oceans.

An obvious conclusion to these facts, when combined with historical perspective, is that the unified commands in the development of their OPLANS and CONPLANS must establish, in conjunction with the specified commands, an organization to plan base/node and LOC development. As with MacArthur's ASCOM, this organization needs to be a combination of engineers and logisticians, and it needs to be joint. It needs to determine the operational sustainment requirements which will flow into and throughout the theater. The LOC requirements need to be developed in conjunction with the commanders vision of operational and tactical requirements. No operational plan can be developed based solely on the requirements to maneuver combat forces. Logis-

tics is operations, thus a complete plan will have been developed jointly with combat, combat support and combat service support staff members and commanders involved in the process.

The major challenge of operational sustainment over lines of communication is the ability to compress the time/space continuum to achieve responsive support. And: " The best system of communication is powerless if there is no transport." (5) As we have limited assets, this transport and the organization of the LOCs and nodes must be planned and organized in peacetime when we have the time to reflect upon various contingencies, and it must be incorporated into our plans. The continuum must reflect the various responses to varying levels of intensity.

In undeveloped theaters - which most are - sustainment of heavy forces will have to be conducted by sea. This will require long leadtimes, with only critical resupply being conducted by air. It will thus require port development and/or LOTS. An undeveloped theater will also require work on airfield capability of support whatever aerial resupply that can be made. My experience in this area indicates a continuing peacetime requirement to evaluate the capabilities of existing airfields, ports and highways. Airfields and airports - the two most critical nodes in operational sustainment - must be thoroughly researched in peacetime so that planning in wartime can be effectively conducted. Nodal operations are key to compressing the time/space continuum.

Although many have concluded that logistics is operations, the issue arises concerning the recognition of this fact and what is being done about it. It appears that we are moving in the right direction in many respects. The Navy and the Air Force are in the process of enhancing strategic and operational lift capabilities and the Army's lightening efforts will enhance

deployability. The Army is also buying more capable trucks, which are key to operational sustainment. Also, a joint transportation command is being organized which should enhance both strategic and operational deployment capability.

Field Manual 100-5, Operations, readily acknowledges the importance of sustainment, which indicates that our doctrine is essentially correct. (6) How is this doctrine being incorporated into training and planning, not only among logisticians but tacticians as well? Only a major effort on the part of the Department of the Army will suffice to determine the answer.

My final conclusion concerns the sustainment imperative of 'Improvisation'. In every war the ability to improvise has been crucial in the sustainment area. Both Slim and MacArthur improvised a 'fleet', for example. They improvised because it was a sustainment requirement. FM 100-5 states: " (Improvisation) should be seen not as a substitute for anticipation, but rather as a complement to it." (7) Sustainment will always require improvisation due to limited asset availability, yet it can never be totally improvised. It must be based on a knowledge of what is required and what is possible - tactical and technical expertise. Additionally, the raw materials must be present. Ammunition is not generally available in the types and quantities to support modern weaponry. Improvisation is conducted to minimize shortfalls. Planning is the prime means of minimizing the impact of the time/space continuum.

Operational sustainment over extended or restricted LOCs is an issue that must be addressed in peacetime. It can be addressed in specifics despite the fact that tactical operations in the same theater may be addressed only generally. I can think of no greater requirement on the part

of unified and specified commands, as well as on the part of the DA DCSLOG, than to plan for sustainment operations, to include nodal and LOC organization and operation. Time and space can be friends or enemies. It would be a tragedy to wait until wartime to find out which they are.

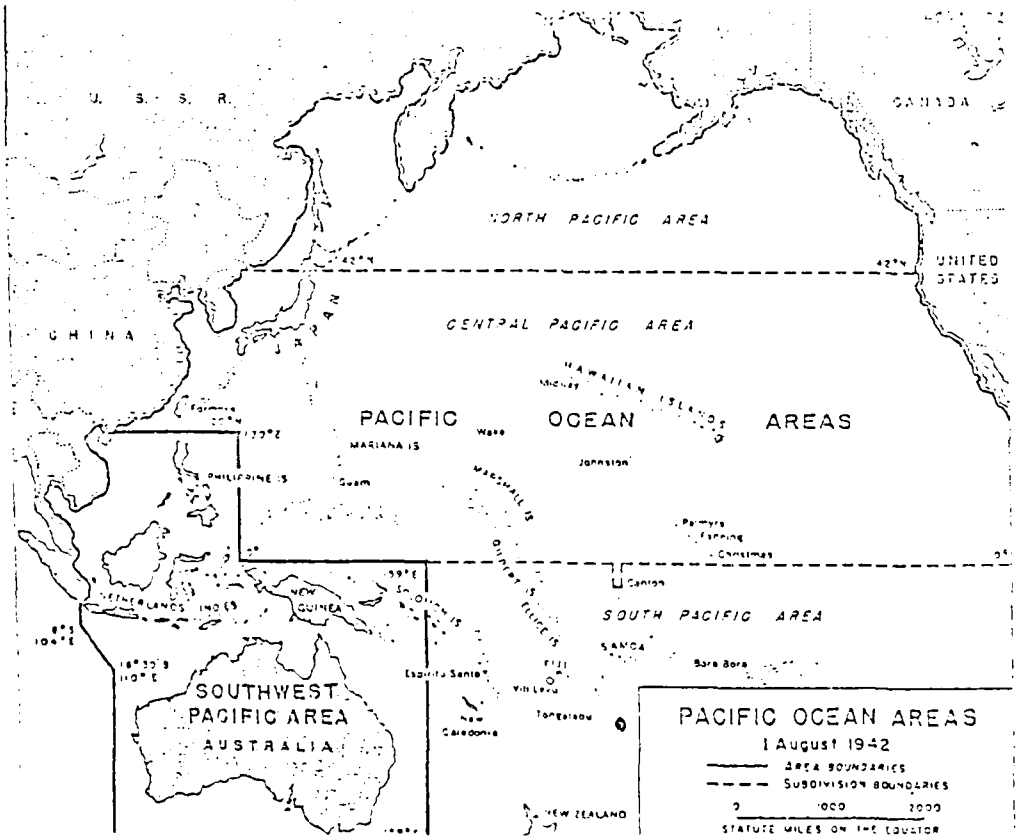
Although it is beyond the scope of this paper to examine how the Department of Defense is preparing to conduct operations, the implications of this paper are clear. First, operational sustainment is a joint effort, and thus requires clear determination and delineation of responsibility for the development, organization and operation of sustaining bases, lines of communication and nodes. The JCS must take the lead on this issue. Secondly, a focused effort on the part of DoD and the separate services must be made to examine the historical lessons of sustainment operations and impart these lessons to both tacticians and logisticians at appropriate educational institutions. Finally, an examination must be made of modern sustainment requirements, in various theaters and at varying levels of intensity, and a determination made of how these requirements will be met. This examination must include the physical methods of transport, the location, availability and suitability of personnel within and without the DoD system to operate the sustainment system, and a realistic appraisal of host nation support.

These issues are of key operational sustainment importance. Their resolution in peacetime will be a key factor in success in wartime.

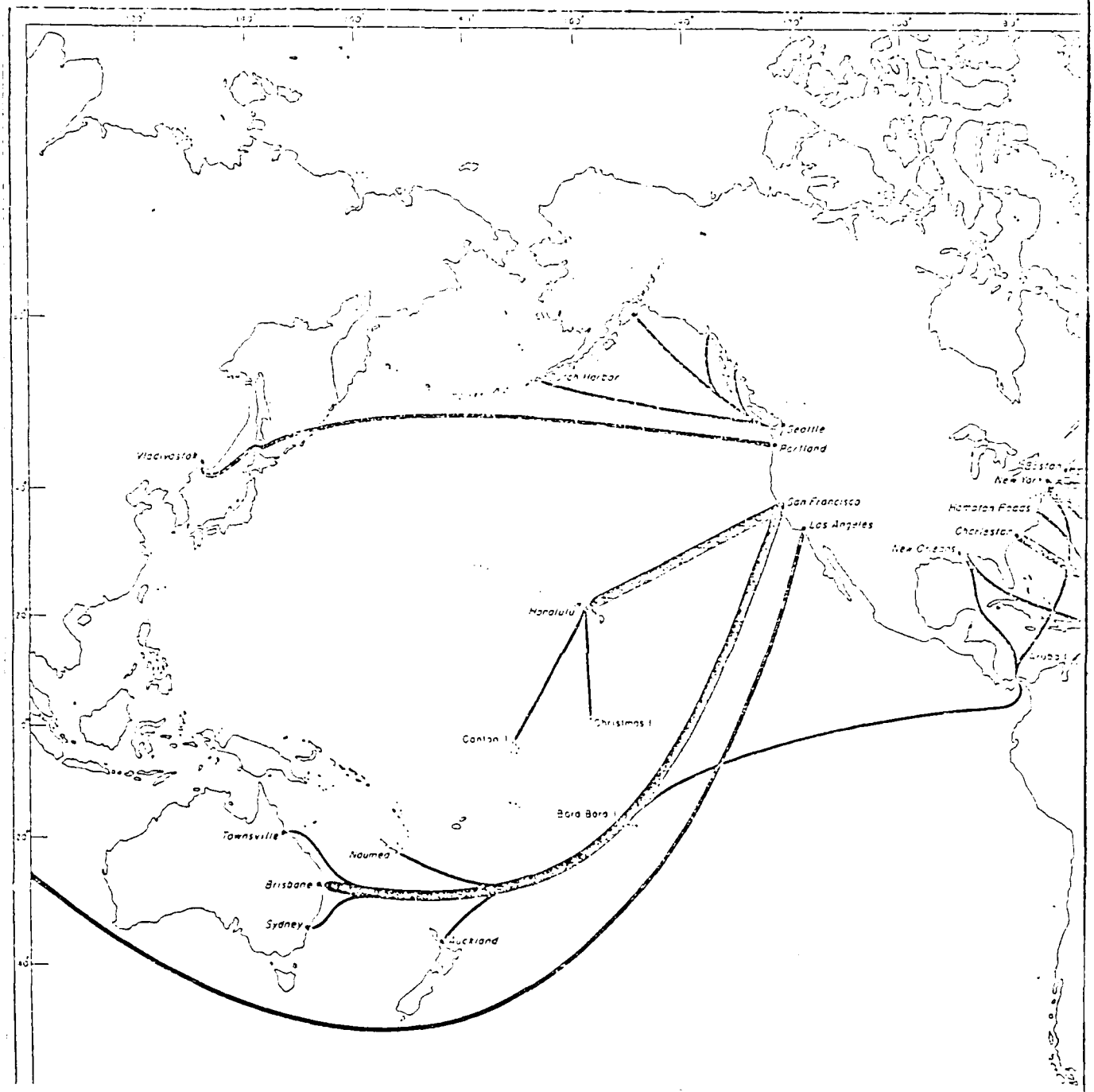
APPENDIX A

MAPS AND CHARTS

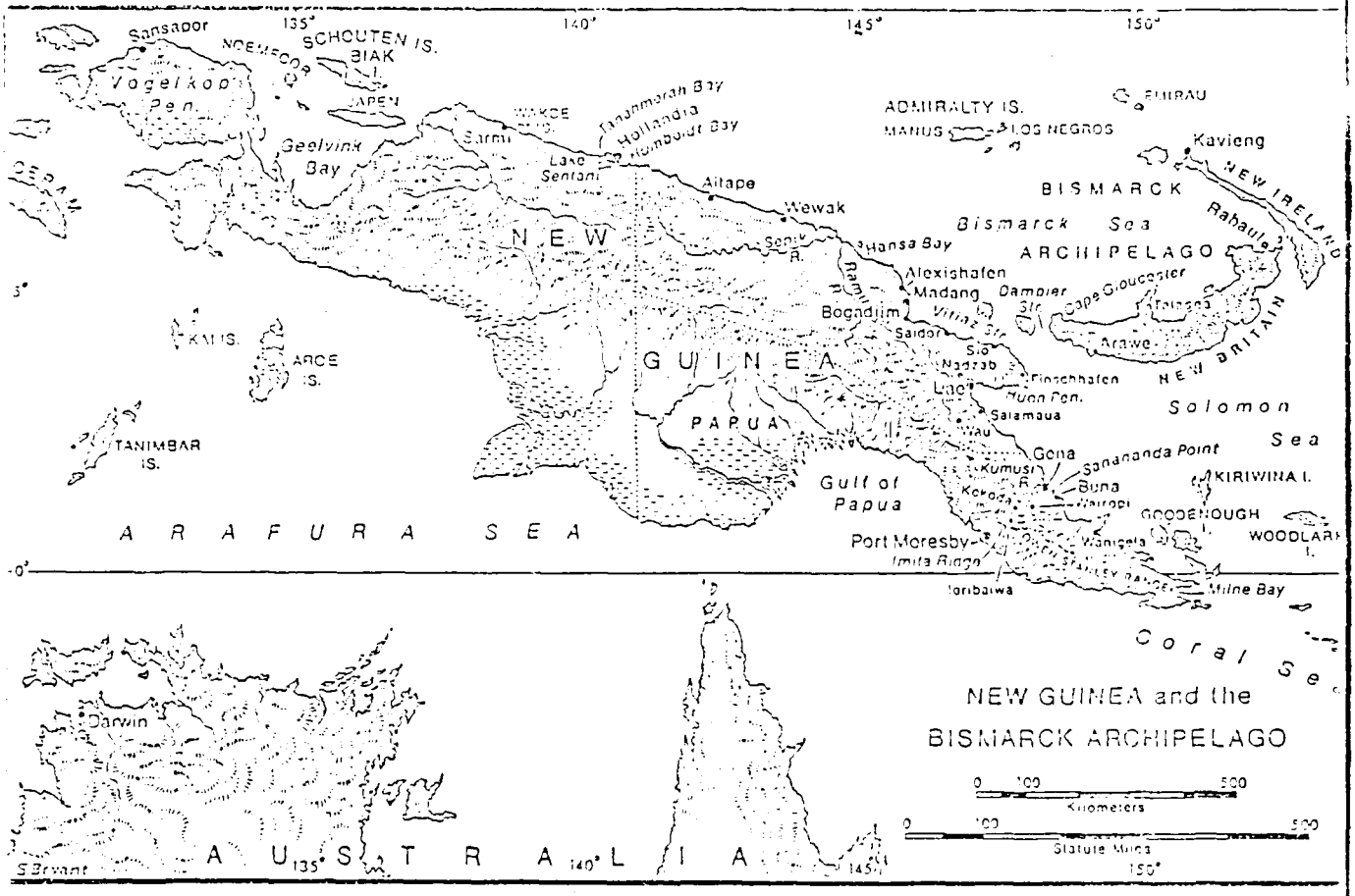
Map 1. The South West Pacific Area

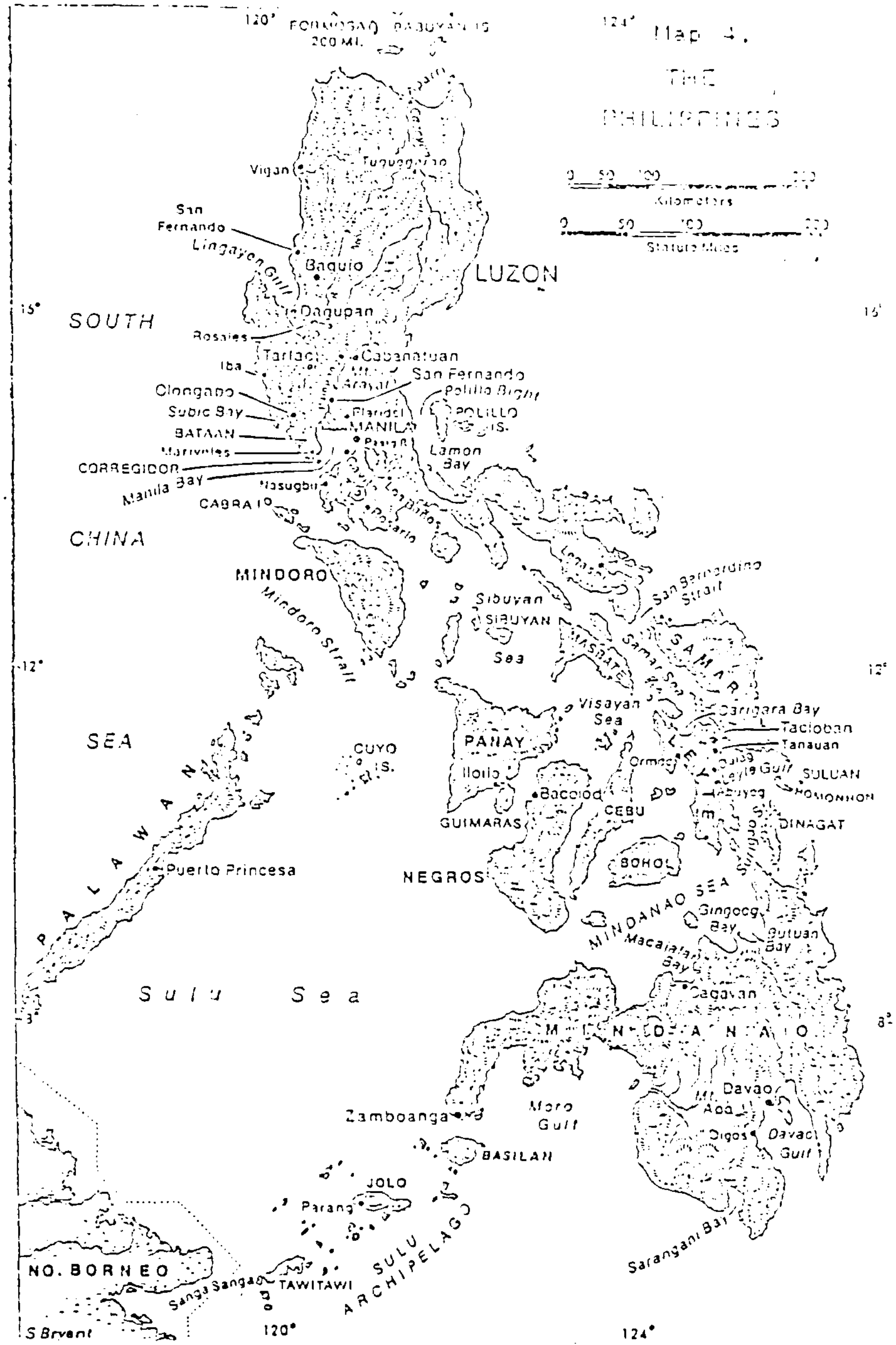


Map 2. Pacific Lines of Communication

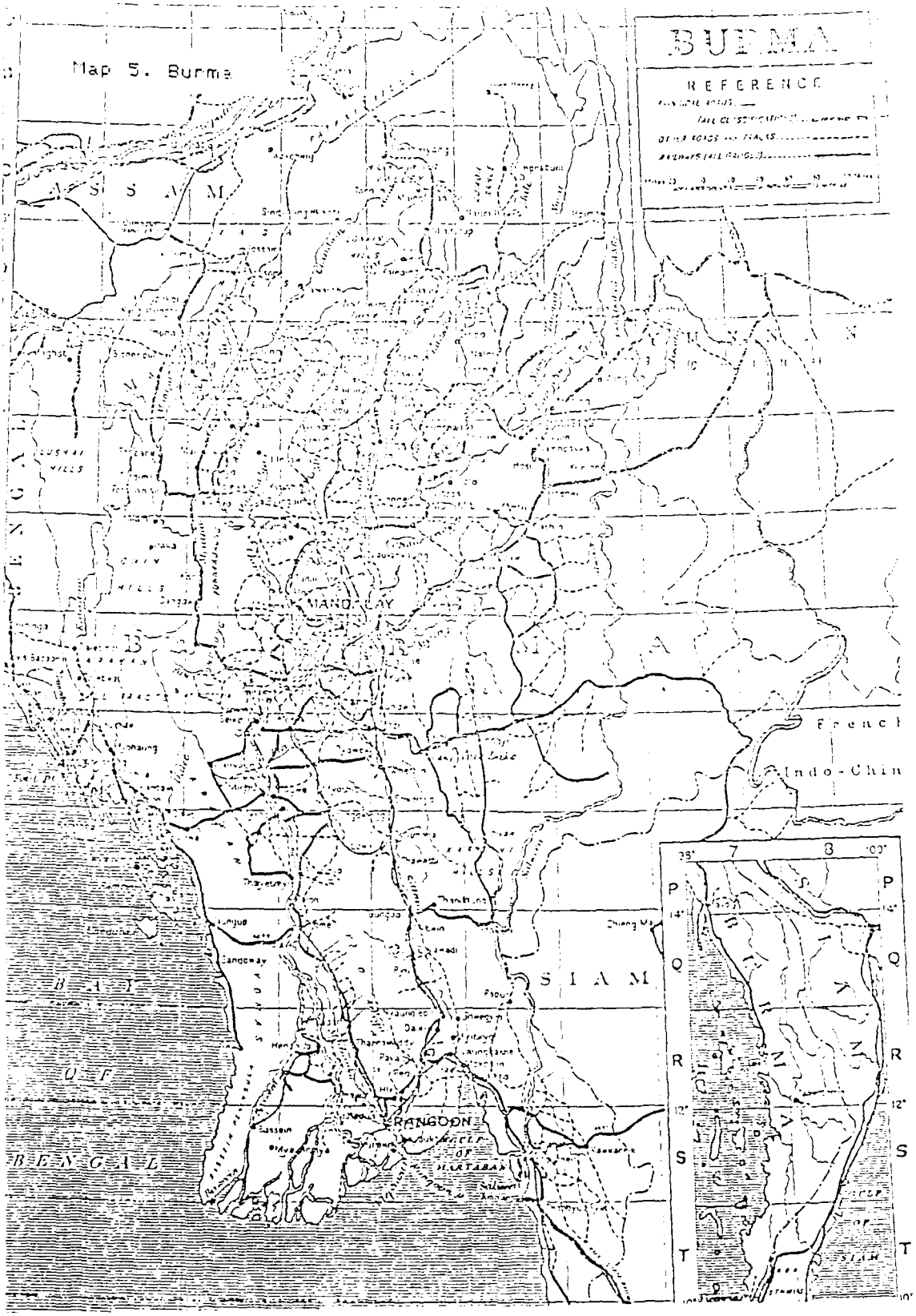


Map 3. New Guinea

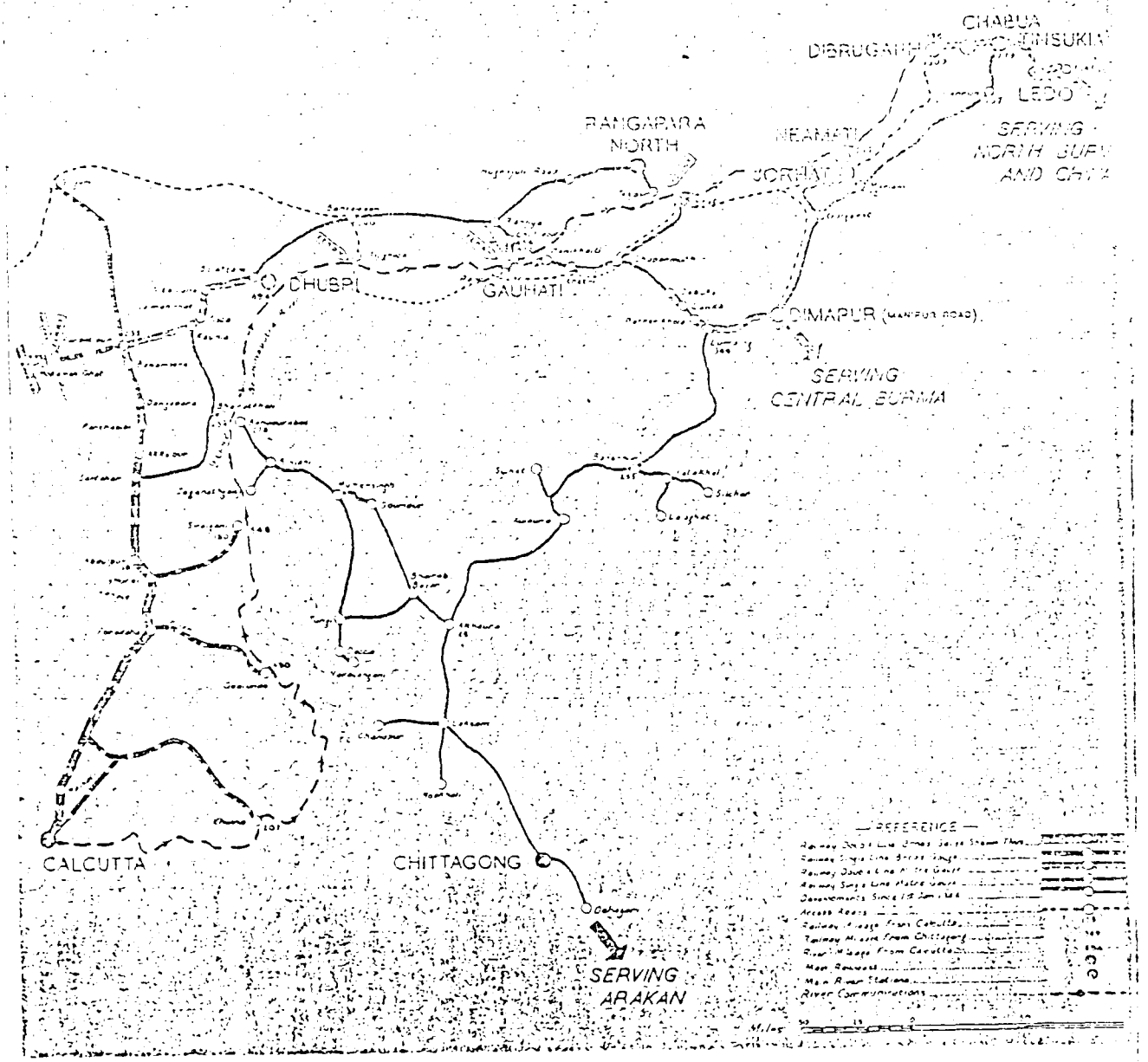




Map 4.
120°
124°
200 MI.
Kilometers
Statute Miles
Vigan
San Fernando
Lingayen Gulf
Baguio
LUZON
Dagupan
SOUTH
CHINA
SEA
Rosales
Tarlac
Cabanatuan
Iba
San Fernando
Olongapo
Subic Bay
Polillo Bight
POLILLO IS.
BATAAN
MANILA
Mariveles
Lamon Bay
CORREGIDOR
Manila Bay
Nasugbu
CABRA I.
MINDORO
Mindoro Strait
Sibuyan
SIBUYAN
Sea
San Bernardino Strait
MASBATE
Samar Sea
SAMAR
Carigara Bay
Tacloban
Tanauan
Visayan Sea
PANAY
CUYO IS.
Iloilo
Ormoc
Leyte Gulf
SULUAN
HOMONHON
Bacolod
CEBU
GUIMARAS
DINAGAT
PALAWAN
Puerto Princesa
NEGROS
BOHOL
MINDANAO SEA
Gingoog Bay
Butuan Bay
Macajalar Bay
Cagayan
Sulu Sea
MINDANAO
Davao
Mt. Apo
Digos
Davao Gulf
Moro Gulf
Zamboanga
BASILAN
JOLO
Parang
SULU ARCHIPELAGO
NO. BORNEO
Sanga Sanga
TAWITAWI
Sarangani Bay
S Bryant
15°
12°


BURMA
REFERENCE
Map 5. Burma
MANDALAY
RANGOON
SIAM
BAY OF BENGAL
French Indo-China

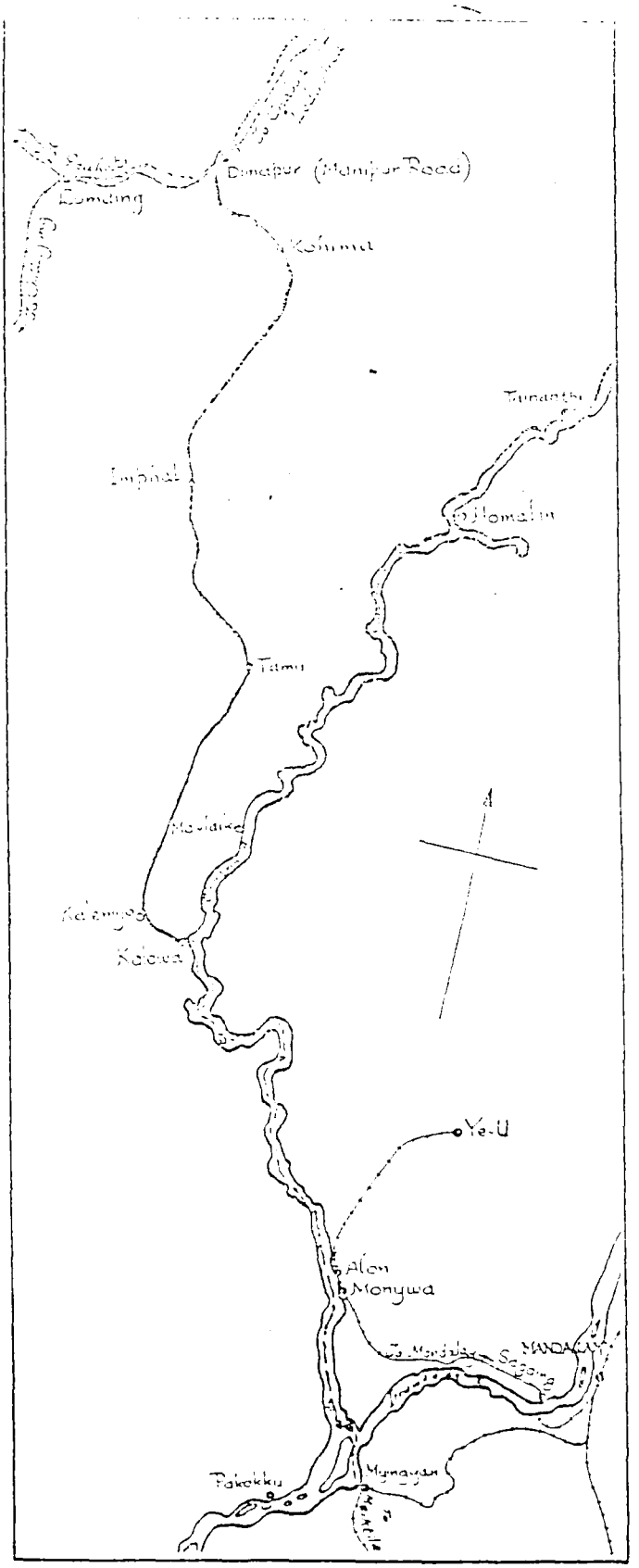
ASSAM——LINES OF COMMUNICATION MAP 6.



Map 7.

LINE OF COMMUNICATION FROM DIMAPUR TO CENTRAL BURMA

OPENED
TO ALON : 1 FEBRUARY 1945
TO MYINGYAN : 26 MARCH 1945

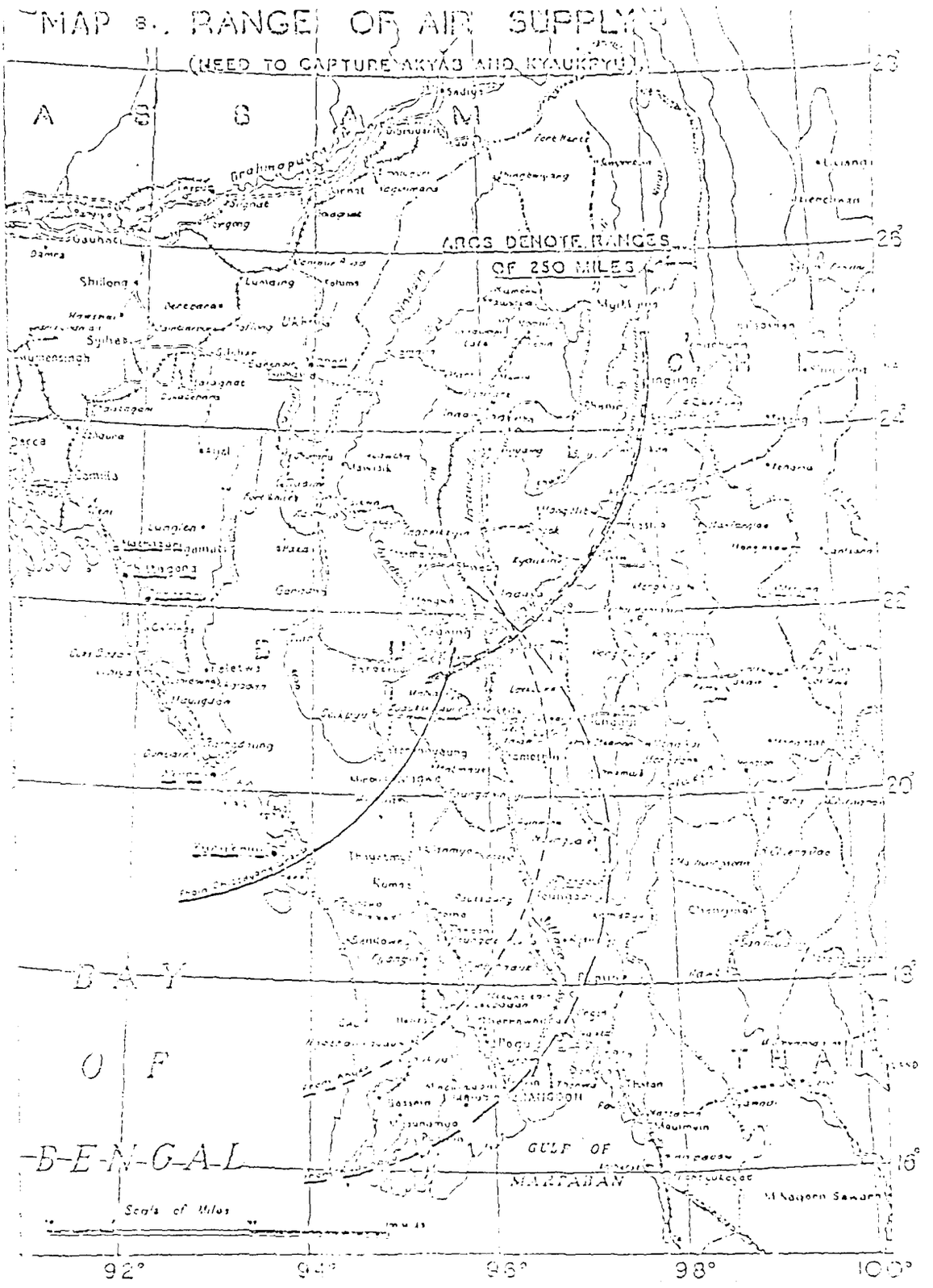


KEY

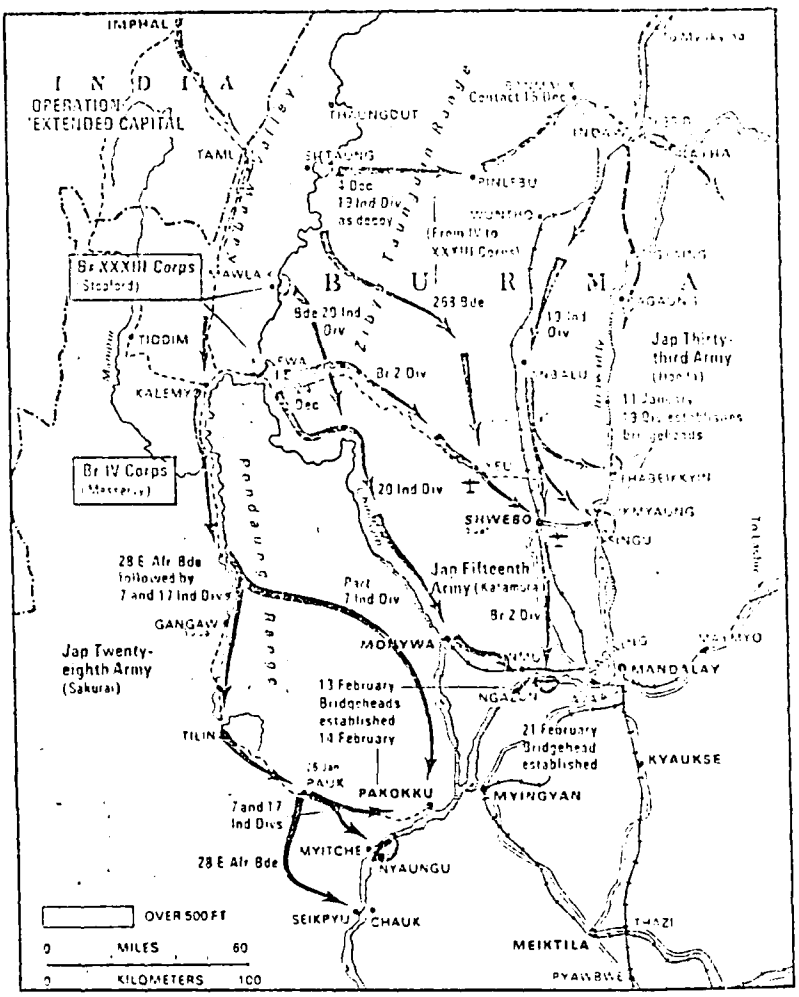
Road
Railway
Waterway

SCALE

MILES 30 MILES


MAP B. RANGE OF AIR SUPPLY
(NEED TO CAPTURE AKYAB AND KYAUKPYU)
ARCS DENOTE RANGES
OF 250 MILES
A S S A M
B A Y
O F
B-E-N-G-A-L
GULF OF
MARTABAN
THAI
Scale of Miles
92°
94°
96°
98°
100°
28°
26°
24°
22°
20°
18°
16°

Map 9. Slim's Drive to the Irrawaddy



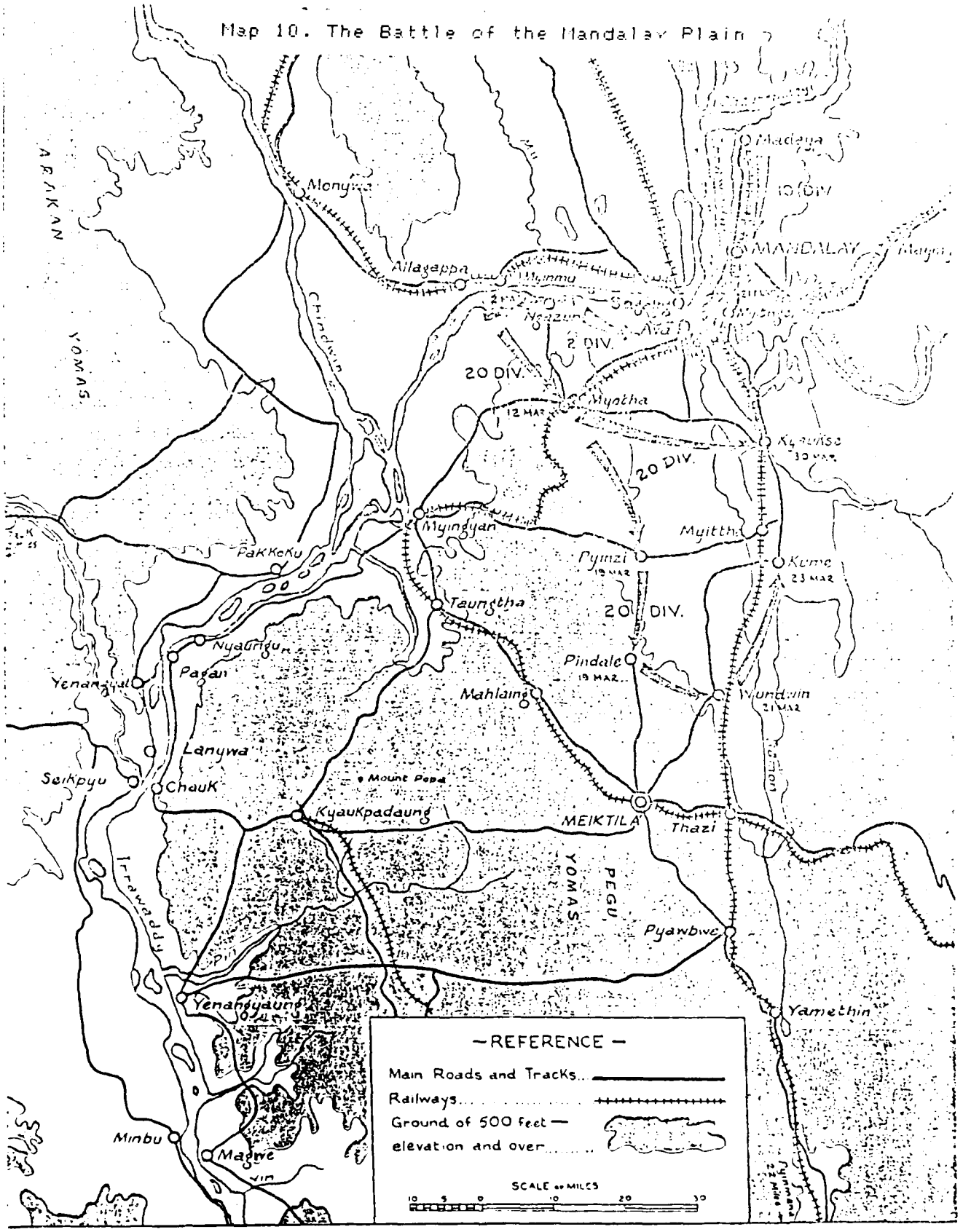

Map 10. The Battle of the Mandalay Plain
ARAKAN YOMAS
Monywa
Ailagappa
Mhinmu
Sagaing
Ngazun
Madaya
10 DIV.
MANDALAY
Maymyo
2 DIV.
20 DIV.
Myotha
12 MAR
Kyaukse
30 MAR
20 DIV.
Myingyan
Myitthe
Pakkoku
Pymzi
19 MAR
Kume
23 MAR
Taungtha
20 DIV.
Nyaungu
Pagan
Pindale
19 MAR.
Yenangyat
Mahlaing
Wundwin
21 MAR
Lanywa
Seikpyu
Chauk
Mount Popa
KyaukPadaung
MEIKTILA
Thazi
Irrawaddy
YOMAS
PEGU
Pyawbwe
Yenangyaung
Yamethin
Minbu
Magwe
REFERENCE
Main Roads and Tracks
Railways
Ground of 500 feet elevation and over
SCALE of MILES
10 5 0 10 20 30

Chart 1. Organization of the South West Pacific Area

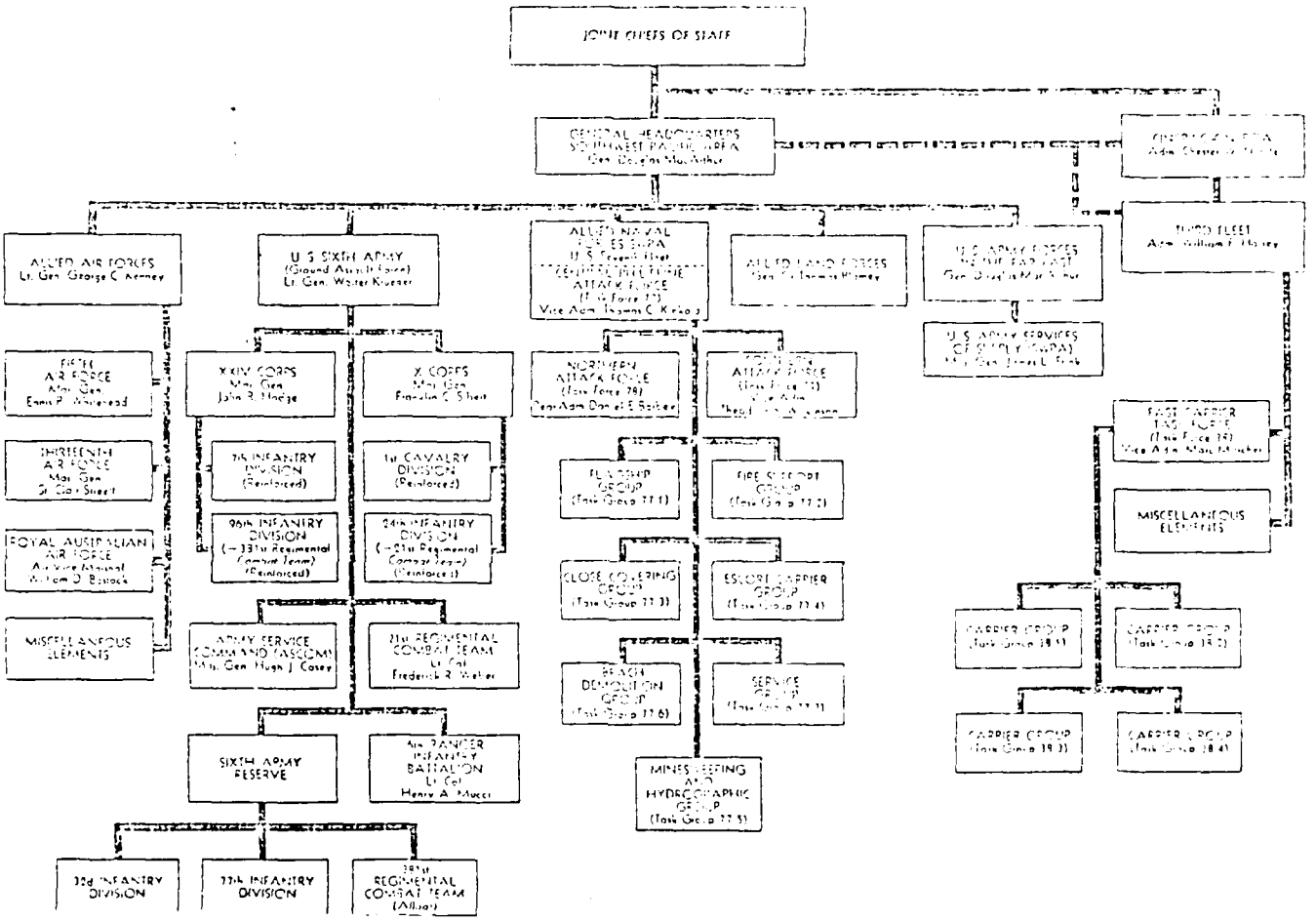


CHART 2. DIVISIONAL SUPPLY REQUIREMENTS

	SHORT TONS OF SUPPLY REQUIRED			
CLASS OF SUPPLY	ARMORED DIVISION (18K PERSONNEL)	MECHANIZED DIVISION (17K PERSONNEL)	LIGHT DIVISION (13K PERSONNEL)	
I	34.38	32.47	24.83	
II	33.03	31.195	23.355	
III(P)	18	16	4	(2)
III(B)	3153.3	1660	662.4	
IV	76.5	72.25	30	(1)
V	1766.92	1593.8	784	(3)
VI	28.8	27.2	20.8	
VII	135	127.5	15	(1)
VIII	10.98	10.37	7.8	
IX	22.5	21.25	4	(1)
WATER	180	170	130	
TOTALS	5439.41	3762.04	1706.69	
	58% FUEL 32% AMMO	44% FUEL 42% AMMO	39% FUEL 46% AMMO	

(1) MY ESTIMATED CORRECTION
(2) MY BEST ESTIMATE
(3) BASED ON AN AVERAGE EXPENDITURE FOR ALL TYPES OF OPERATIONS

Chart 3. Lines of Communication

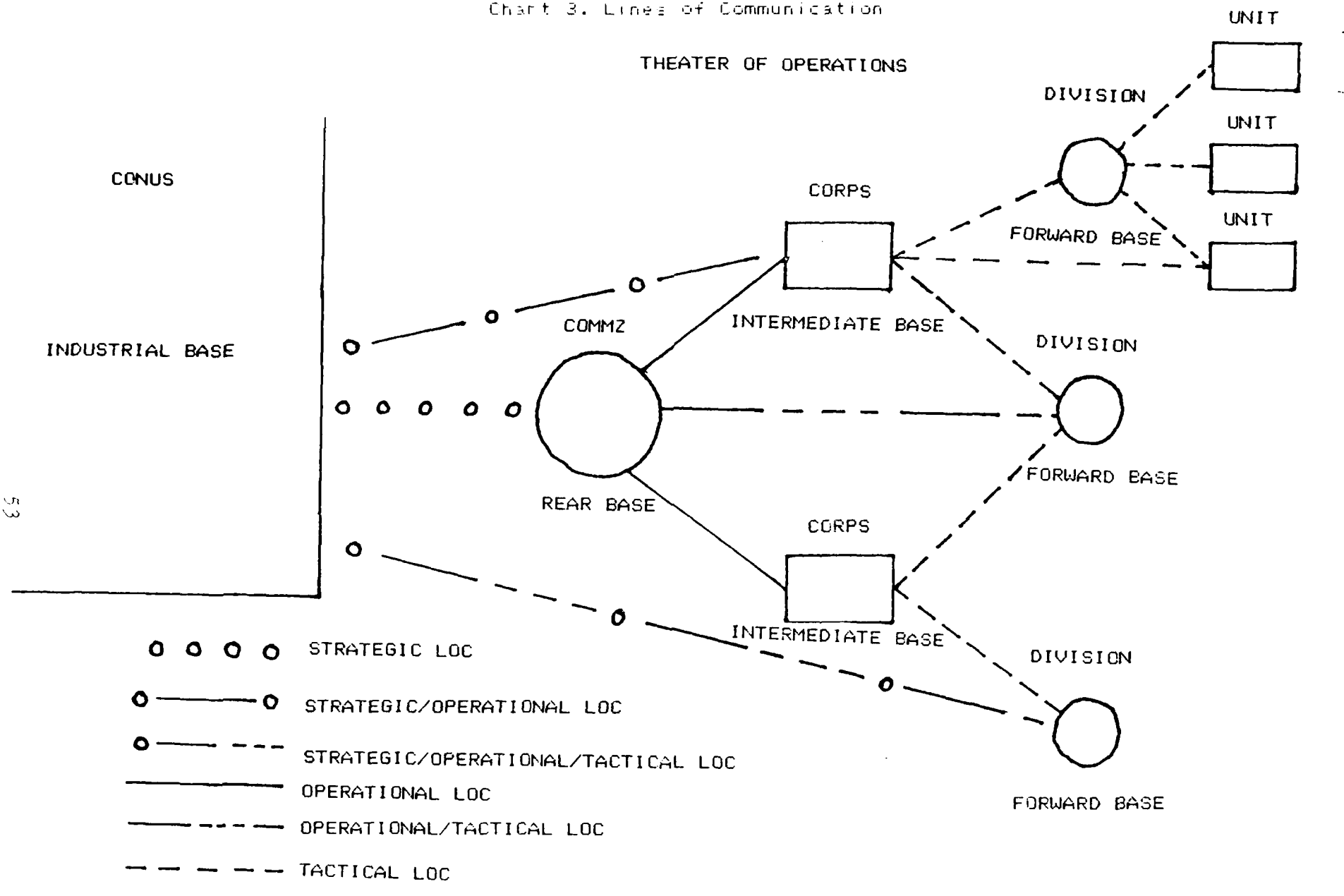
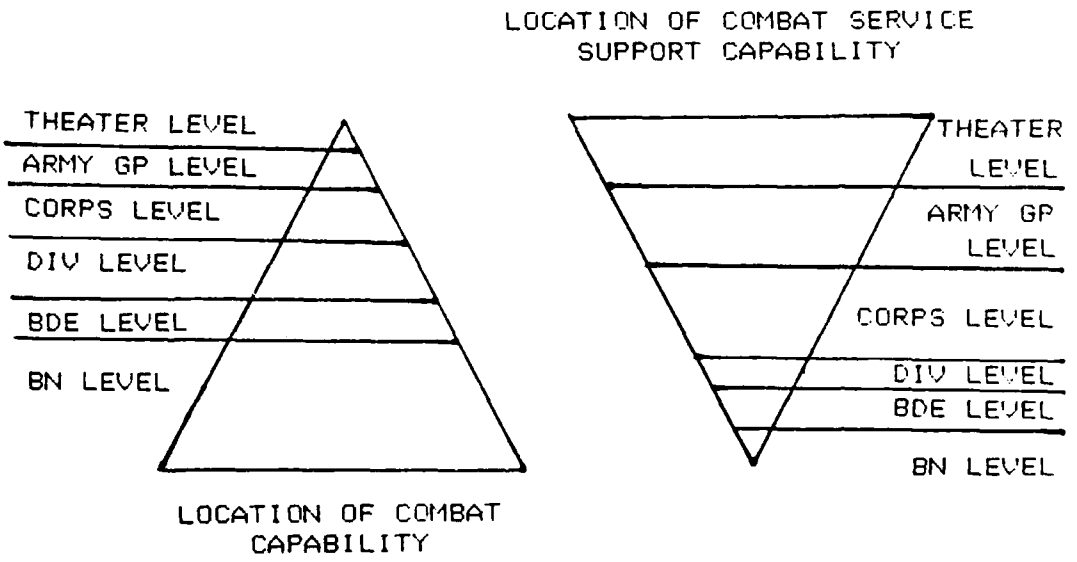


Chart 4. Unit Structures



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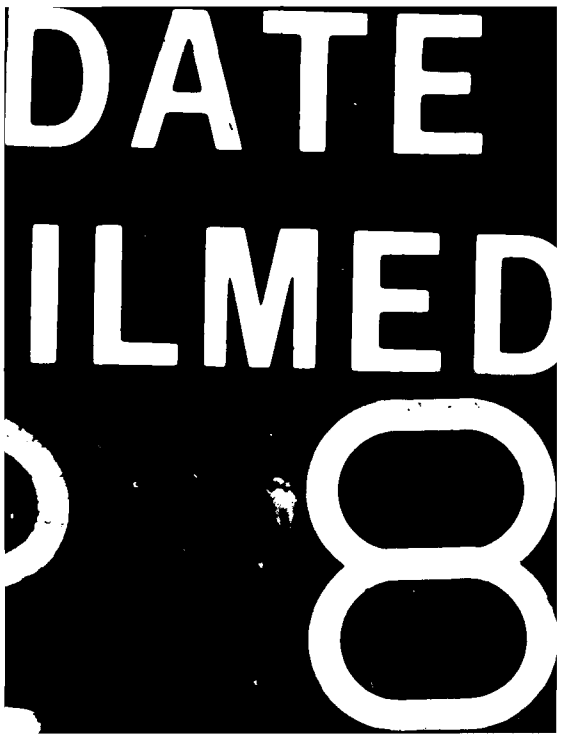
Letter

Professor Martin Van Creveld to author, May 1, 1987, Subject: Permission to use a quote made during his visit to the SAMS on 27 March 1987.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